

# **EXHIBIT A**

**MCAT**  
Medical College  
Admission Test



Excerpts From :

# MCAT<sup>®</sup> Essentials for 2014 and January 2015

## Required Reading

- Registration instructions
- Test-day policies
- Scoring details

...and suggestions to help you prepare for the MCAT exam, a list of contacts and online services, and other helpful information



## The MCAT® Essentials

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The MCAT® Essentials

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## The MCAT® Essentials for 2014 and January 2015

Congratulations! Reading this guide is the first step in preparing yourself to take the MCAT® exam—and the first step toward a rewarding career in medicine.

The *MCAT Essentials* is the official policy and procedure guide to the MCAT exam. On the following pages, you will find fundamental information about registration, test-day policies, rules to protect the integrity of the exam, and post-test procedures. This includes a brief overview of exam content and scoring, basic suggestions to help you prepare, a list of contacts and online services, as well as other helpful information.

The information included in this guide is necessary for a smooth registration and testing experience. At the time of registration, you will be asked to certify that you have read, understand, and agree to comply with the policies and procedures contained within the *MCAT Essentials*.

If you are a returning examinee, you must read the *MCAT Essentials* guide associated with your new registration. The *MCAT Essentials* is subject to change. The version applicable to you is that which was in effect at the time of registration.

Please contact us if you have questions after reading the guide. You will find contact listings for MCAT staff and related resources in Appendix A.

All of us at the AAMC would like to wish you much success as you move forward with your career in medicine. The path you have chosen will have many challenges, but the rewards will long outweigh them.

**Note:** *At the time of seat reservation, you must agree to all the policies and procedures contained within the MCAT Essentials.*





## Part 1: The Essential MCAT

The Medical College Admission Test® (MCAT®) is a standardized examination that has been part of the medical school admissions process for more than 80 years. Virtually all medical schools in the United States and many in Canada require applicants to submit recent MCAT exam scores as part of their application packet, and many health professions and graduate programs now accept MCAT scores in lieu of other standardized tests. Considering its widespread acceptance, it is no surprise that more than 85,000 students sit for the exam each year.

The MCAT exam tests examinees on the skills and knowledge medical educators and physicians have identified as key prerequisites for success in medical school and the practice of medicine. Content is divided into three scored multiple-choice sections, and one unscored multiple-choice section.

In conjunction with its member medical schools, the AAMC develops and administers the MCAT multiple times each year from late January through early September at hundreds of test sites throughout the United States and Canada, as well as selected locations throughout the world.

The AAMC owns all aspects of the exam. We may use scores for research and to create reports that summarize test takers' performance by year or population group, or other large groups. *Only you, the examinee*, may receive your individual test score and authorize its release to others.

## Exam Content

The MCAT exam tests for mastery of basic concepts in biology, general chemistry, organic chemistry, and physics. Additionally, it serves to assess examinees' capacity for problem solving and critical thinking. These concepts are presented in basic science courses offered at most undergraduate institutions. Typically, no advanced coursework is needed to do well on the MCAT exam.

Increasing diversity within the study of medicine is something the AAMC and our members actively promote and endeavor to advance. It is hoped that the content included and the skills tested will encourage people from broad educational backgrounds to apply, and that premedical students will be compelled to explore a wide variety of course offerings outside the natural sciences.

The four sections of the exam, in the order they appear, are:

- Physical Sciences
- Verbal Reasoning
- Biological Sciences
- Trial Section



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The chart below provides an overview of the entire MCAT exam by segment.

Exam Overview		
Section	# of Questions	Time Allotted
Name Confirmation Screen		2 minutes
Examinee Agreement		10 minutes
Tutorial (optional)		10 minutes
Physical Sciences	52	70 minutes
Break (optional)		10 minutes
Verbal Reasoning	40	60 minutes
Break (optional)		10 minutes
Biological Sciences	52	70 minutes
Void Question		5 minutes
Break (optional)		10 minutes
Trial Section (optional)	32	45 minutes
Satisfaction Survey (optional)	12	10 minutes
Total Content Time		4 hours   5 minutes
<b>Total "Seated" Time*</b>		<b>Approx. 5 hours   10 minutes</b>
*Total seated time does not include check-in at the test center.		

***Note:** Each of the three scored multiple-choice sections includes some experimental items. Experimental items, as well as questions contained in the Trial Section, do not count toward your score.*

## Physical Sciences

The Physical Sciences section assesses problem-solving ability in general chemistry and physics. All questions in this section are designed to evaluate your knowledge of basic physical sciences concepts and problem-solving skills.

The Physical Sciences section is divided as follows:

- Total of 52 questions
- 7 passage-based sets of questions
  - 4–7 questions per set
- 13 independent questions



## The MCAT® Essentials

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### Verbal Reasoning

The Verbal Reasoning section assesses your ability to understand, evaluate, and apply the information and arguments contained in each passage. Content is based in the humanities, social sciences, and natural sciences.

The Verbal Reasoning section is divided as follows:

- Total of 40 questions
- 7 passages (approximately 600 words per passage)
  - 5–7 questions per passage

Participation in a variety of undergraduate courses in the humanities, social sciences, and natural sciences will enhance your performance on this section, as will familiarizing yourself with the types of critical thinking and reasoning skills these disciplines use. No advanced study is required.

### Biological Sciences

The Biological Sciences section assesses problem-solving ability in the areas of biology and organic chemistry. All questions in this section are designed to evaluate your knowledge of basic biological sciences concepts and problem-solving skills.

The Biological Sciences section is divided as follows:

- Total of 52 questions
- 7 passage-based sets of questions
  - 4–7 questions per set
- 13 independent questions





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### Trial Section

The Trial Section is a **voluntary section** that asks you to test out questions for a future version of the MCAT exam.

The MCAT exam will change in 2015 to keep pace with changes in medical education and health care. Building the new exam will call for many new test questions. Medical schools would like your help in building the next version of the MCAT exam by answering the questions in the Trial Section.

On test day, you will have the opportunity to volunteer for the Trial Section. **It will be the last section of the test and take 45 minutes to complete.** You do not need to prepare for the Trial Section. The questions you will get are based on the answers that you provided during MCAT registration regarding the courses that you have taken. Whenever possible, the AAMC will assign questions from courses you have already completed.

You don't have to worry about not doing well, just try your best. No one will know how well you did but you—not the medical schools or your advisor. Your answers on the Trial Section will not contribute to your MCAT scores in any way. If you volunteer to participate, you will have an opportunity to preview content that medical school admissions officers want applicants to know. You also will receive the following if you put forth a good-faith effort:

- A \$30 Amazon.com® Gift Card\* Claim Code\*\* emailed to you within three to four weeks
- Feedback on your performance that will allow you to compare yourself to others who participated in the Trial Section

If you elect to void the scored portion of the MCAT exam, you will not be given the opportunity to participate in the Trial Section.

Please note that you cannot preregister for the Trial Section. However, you will be invited to take the trial section ONLY after you complete the core “scored” sections of the exam, select ***“I wish to have my MCAT exam SCORED,”*** and lastly, answer ***“yes”*** to the statement ***“Please indicate below if you would like to participate in the Trial Section.”***

We are grateful for your help! Medical schools will use the future version of the MCAT exam to select the first-year students who will join you when you're a seasoned medical student. Please help the medical schools select students who will be great colleagues for you and the next generation of health care providers.

To provide feedback to the AAMC after the Trial Section, please email us at [mcats2015@aamc.org](mailto:mcats2015@aamc.org).



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## Exam Scoring

You will receive a separate score for each of the first three content sections of the MCAT exam, as well as a total score. The following explains scoring in detail and highlights certain aspects of the process.

***Note:** Examinees who elect to void the scored portion of the MCAT exam will not receive a score on the exam and will not be given the opportunity to participate in the Trial Section.*

## Physical Sciences, Verbal Reasoning, and Biological Sciences

- These sections are scored from a low of 1 to a high of 15.
- Every form of the MCAT exam measures the same basic skills and concepts. However, each form is different in regard to the specific questions it uses. Because each form has the potential to be easier or slightly more difficult than another, raw scores are converted to a scale that takes into consideration the level of difficulty of the test questions on a given form. This conversion minimizes variability in the meaning of test scores across forms.
- There is no penalty for guessing.
- Your total score is the sum of the three individual section scores.

## Trial Section

- This section is not scored, though examinees who put forth a good-faith effort in completing the Trial Section will receive feedback on their performance as well as a \$30 Amazon.com® Gift Card.

# **EXHIBIT B**

**MCAT**  
Medical College  
Admission Test



Excerpts From:

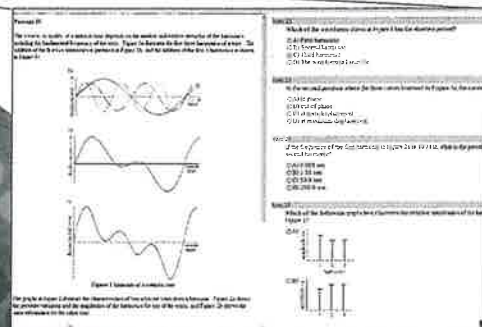
**Second Edition**

# The Official Guide to the MCAT<sup>®</sup> Exam



## Includes:

- Actual MCAT questions from previous exams
- Detailed solutions from the test developers
- Current examinee data
- A look at MCAT scores as part of the admissions decision
- ...and much more!



# Chapter 1:

## Overview of the MCAT® Exam

### Questions Answered in this Chapter:

What Is the Role of the Exam?

Does It Test Knowledge or Reasoning Skills?

What Is the Breakdown of the Exam, and Why Is It So Varied?

One of our MCAT staffers overheard a couple of college juniors commiserating with one another about the MCAT exam that loomed ominously in their futures. After about 20 minutes of nonstop talk about various review courses, prep books, practice options, and the sheer arduousness of it all, one student stopped mid-sentence, looked at the other, and asked with a mix of exasperation and fear, “Why do they DO this to us?” The other student shook her head and shrugged in empathy, but we know the answer. It’s amazingly simple:

*Because the MCAT exam does its job.*

### I. What Is the Role of the Exam?

The MCAT exam, taken by more than 70,000 students each year, serves as a reliable screening tool for medical school admissions officers who seek to identify which applicants are most likely to succeed in medical school—and beyond—and which are not. In doing so, admissions officers look not only for students whose base knowledge of scientific concepts will serve as a strong foundation in the early years of medical study, but also for those with strong critical reasoning ability and strong written communications skills. And the MCAT exam spots those students well.

So do college grades. But when admissions officers look at MCAT scores in conjunction with undergraduate GPAs—as opposed to grades alone—their ability to predict who will be successful in medical school increases by as much as 50 percent (gauging by first- and second-year medical school grades).<sup>\*</sup> That explains why virtually every medical school in the United States, and many in Canada, require applicants to submit recent MCAT scores.

<sup>\*</sup> Those of you who wish to explore the data might want to review the article, “Validity of the Medical College Admission Test for Predicting Medical School Performance”, published in *Academic Medicine* and available online at [www.aamc.org/mcatguide](http://www.aamc.org/mcatguide).



Now that we've added to what undoubtedly is already a high level of anxiety, we'd like to quell your fears: There's more to passing the admissions hurdle than getting high MCAT scores, and a less-than-stellar showing does not mean you cannot be admitted to medical school. Research shows, in fact, that some students with relatively low scores on one or more sections of the test can gain admittance if other factors, such as a high GPA, tip the scales in their favor. (Conversely,

**The methods by which MCAT scores are used in conjunction with other selection factors are discussed in Chapter 5, "Your MCAT Score as Part of the Decision-Making Process."**

students with high MCAT scores and low grades may not find a berth.)\* Among the other factors that enter into the admissions decision are the selectivity of your undergraduate institution, letters of recommendation, the interview, a history of community service and/or medically-related work, and personal character traits such as integrity and determination.

*"Items should be designed to ascertain not simply the examinee's basic knowledge of science or rote memorization of facts, laws, and definitions, but rather the ability to reason or apply this knowledge to specific situations. The examinee is expected to reason through a problem by applying the background knowledge obtained through introductory-level college coursework."*

MCAT Item Writer's Guide, AAMC

## II Does It Test Knowledge or Reasoning Skills?

We hear the same argument over and over again. Some insist the MCAT exam is a knowledge-based test, designed to assess your mastery of a full range of science topics. Others claim it is really a thinking test, intended to evaluate your problem-solving capacity.

Everybody's right. The fact is that the exam tests knowledge and thinking. You can take it right off the pages of the MCAT Item Writer's Guide, the guidelines we provide to the writers who develop the actual passages and related questions. (See box at left.)

Before we move on, we'd like to draw your attention to the word "basic" in the excerpt above. The exam, while indeed requiring that you have a foundation of science upon which to draw (most notably biology, chemistry, and physics), tests nothing more than that ordinarily covered in introductory or entry-level classes.

*There is no proven benefit to advanced coursework when it comes to MCAT scores.*

While you may find that higher-level science courses better prepare you for medical school in general, there is no evidence that advanced classes lead to higher MCAT scores specifically.

Other areas of the exam, specifically Verbal Reasoning (VR) and the Writing Sample (WS), have no knowledge to test and are therefore clearly a test of one's reasoning and writing skills. These sections are designed to assess your ability to comprehend, evaluate, and synthesize new material; develop concepts; and present ideas in a logical, well-written manner.

What all of this should tell you is that if you haven't mastered the science that's tested on the exam, you won't be able to score well—no matter how well you try to reason your way through a passage. Conversely, rote knowledge alone isn't sufficient, since you've got to apply that understanding to solve the problem. You've got to "know your stuff" and be able to think things through—two traits that every doctor must have.

\*See chart, "Likelihood of Admission," on page 39 for more information.



### III. What Is the Breakdown of the Exam, and Why Is It So Varied?

When you look at the format of the exam described below, it's apparent that the purpose of the MCAT exam is to help medical school admissions officers and faculty gauge a student's reasoning skills as well as his or her mastery of basic concepts in biology, general and organic chemistry, and physics. But screening for the two crucial attributes that medical educators have identified as key prerequisites for success—a basic foundation in science and a strong capacity for critical thinking—is just one reason the MCAT exam is structured as it is.

#### EXAM STRUCTURE

Test Section	Number of Passages	Number of Questions	Time
Tutorial (optional)			10 minutes
Non-Disclosure Agreement			10 minutes
Physical Sciences	7	52	70 minutes
Break (optional)			10 minutes
Verbal Reasoning	7	40	60 minutes
Break (optional)			10 minutes
Writing Sample		2	60 minutes
Break (optional)			10 minutes
Biological Sciences	7	52	70 minutes
Void Question			5 minutes
Satisfaction Survey			10 minutes
Total Content Time			4 hours, 25 minutes

**Total "Seat" Time** 5 hours, 25 minutes

**Total time does not include check-in time on arrival at the test center.**

Beyond that, medical school faculty hope to encourage undergraduates with broad educational backgrounds to consider careers in the health professions, and similarly, they want to persuade premed majors to explore a wide variety of courses outside of the natural sciences. That explains why the exam tests for such diverse abilities and knowledge, and why everyone, from English majors to history buffs, has an equal crack at achieving a high score (assuming, of course, they have mastered the entry-level science courses necessary for success on the MCAT exam)\*.

#### Structure of the Exam

We cover the full outline of topics later in this guide, but for now, we'll give you the overview. The MCAT exam is a computer-based test that lasts just over five hours (including optional breaks) and consists of three multiple-choice sections—Physical Sciences, Biological Sciences, and Verbal Reasoning—along with a writing assessment.

\*See chart on page 34, which presents the mean and median scores of applicants by undergraduate major.

Here's a closer look at these sections, described in the order you will receive them in the exam:

• **Physical Sciences: 70 minutes**

The Physical Sciences (PS) section covers general chemistry and physics. A total of 52 questions are presented in two formats—passage-based and independent:

- Most questions are based on *passages*, each about 250 words in length, which describe a situation or problem. All told, there are seven passages, each containing from four to seven questions, for a total of 39 passage-based questions.
- In addition, there are 13 *independent* questions—those not associated with a passage.

For this section, you will be tested on your capacity to interpret data presented in graphs and tables, your knowledge of basic physical science concepts and principles, and your ability to solve problems using that knowledge as a foundation.

Please note that each multiple-choice section (PS, VR, and BS) will include some try-out items that do not count toward your score.

**How Did We Decide Which Science Topics to Cover?**

The decision as to which science topics we cover involved a two-step process:

- We asked medical educators, students, residents, and physicians to rate potential topics on their importance to the study and practice of medicine.
- At the same time, we surveyed faculty members at undergraduate institutions to learn which topics are covered in introductory courses—and to what degree.

The topics that were identified as prerequisite for success in medical school and covered in most undergraduate courses were selected for inclusion in the test.

• **Verbal Reasoning: 60 minutes**

The Verbal Reasoning (VR) section evaluates your ability to understand, evaluate, and apply information and arguments presented in writing.

This segment consists of seven passages, each about 600 words long, taken from the humanities and social sciences, and from areas of the natural sciences not tested in the science segments of the exam. Each passage-based set consists of five to seven questions, with some designed to test your basic comprehension of the text and others intended to gauge your ability to analyze information, evaluate the validity of an argument, or apply knowledge gained from the passage itself.

**No Specific Subject Knowledge Required for VR**

It's important to realize that you won't be tested for specific subject knowledge in this segment of the exam. Instead, all the information you'll need is contained within the passage itself.

### How Much Does the Writing Sample Count?

The short answer: it depends. The weight assigned to your performance in this segment of the exam varies from school to school. That said, there are indeed situations where your performance on the WS can make a difference. For example, some admissions committees will take a close look at your WS score when your VR score is at the lower end of the scale.

#### • Writing Sample: 60 minutes

The Writing Sample (WS) consists of two 30-minute essays, each addressing specific topics that require a written response. This segment of the exam assesses your skill in developing a central idea; synthesizing concepts and ideas; presenting ideas cohesively and logically; and writing clearly, with the ability to follow accepted rules of grammar, syntax, and punctuation.

#### • Biological Sciences: 70 minutes

The format of the Biological Sciences (BS) section, which covers biology and organic chemistry, is identical to that of the PS section. It too has seven passages, each containing four to seven questions, for a total of 39, and 13 independent questions. Similarly, this segment tests knowledge of basic biological sciences concepts and the ability to incorporate that knowledge in solving problems.

*For an outline of the science content covered; a description of skills assessed; and sample passages, questions, and solutions, please see Part II.*

# Chapter 10:

## Verbal Reasoning (VR)

### Included in this Chapter:

Overall Section Format  
Content Areas  
Cognitive Skills Assessed  
Introduction to Practice Sets  
for Verbal Reasoning  
Practice Sets of Sample  
Passages, Questions, and  
Solutions

As we move beyond the two sciences sections and on to Verbal Reasoning, it's obvious we're dealing with very different substance. That's because, unlike the sciences, this part of the exam does not require mastery of any particular subject matter and instead is solely a test of one's reasoning skills. Everything you'll need to answer VR questions can be found within the passages themselves.

In other words, there's no real content to study.

That's not to say, though, that there's no real way to get ready. Just as with the PS and BS sections, you'll gain by knowing what to expect in terms of content, understanding the skills we're assessing, and preparing with real MCAT passages and questions. Here again, we provide you with those very tools.

### VR Section Recap

- Seven passages with five to seven questions each, for a total of 40 questions
- 60 minutes

### I. Overall Section Format

The Verbal Reasoning section is composed of 40 passage-based, multiple-choice questions that test your ability to read attentively and make reasonable inferences based on the information provided to you. These passages are selected and adapted from a variety of publications intended for well-educated readers—material similar to those a college junior would be assigned.

It's important to realize that you are not expected to have any background knowledge about these subjects or any previous expertise in them. Rather, the correct answer for each question can either be found directly in the passage itself or by applying the information within the passage to any new information contained within the question.

### How General Reading Can Help You Prepare

Remember the first Shakespeare play you read? Although you initially may have been thrown by the 16th (and early 17th) century English, you probably had a much easier time of it with the next play, and easier still with the one after that. You became accustomed to the language.

The same holds true for reading passages that address a topic within humanities, social sciences, or natural sciences—especially for science majors whose coursework did not involve as much of this type of reading as, say, humanities majors.\* You'll become more proficient with it, and these passages will seem less "foreign."

\*In fact, some might conjecture that humanities majors score higher in VR than biology majors because the former are more accustomed to this very type of reading!



## II. Content Areas

With that, let's move on to a description of the three broad content areas from which the VR passages are drawn.

### 1. Humanities

Passages in the humanities area are drawn from excerpts in *architecture, art, literature, music, philosophy, popular culture, religion, and theater*. Often focusing on relationships between ideas, humanities passages are more likely to be written in a conversational or opinionated style than the passages in the social sciences and the natural sciences and technology areas. You may therefore be required to glean information from the author's tone and word choice in addition to the passage assertions themselves.

#### Tips to Keep in Mind

Some tips to help you with the VR section...

- Pay attention to any qualifying language. Notice, for example, whether the question asks if something is least or most likely or whether a fact is always, never, or sometimes true about all, a few, or most of something.
- Make sure you answer the questions based solely on the information provided by the author and not on your background knowledge of a subject.
- With seven passages and 60 minutes, you have an average of eight minutes per passage. Pace yourself!

### 2. Social Sciences

Passages in the social sciences focus on *anthropology, archaeology, economics, education, history, linguistics, political science, psychology, and sociology*. These excerpts frequently center on the interpretation, implications, or applications of research in the social sciences, and often are based on studies about people in general or particular social groups. Frequently these passages are structured around a central claim that is either being supported or undermined by the information provided by the author. Sometimes the information in these passages can be very "rough" because the passage deals with complex issues and events in an artificially simplified manner.

### 3. Natural Sciences and Technology

With the focus on *astronomy, botany, computer science, ecology, ethology, geology, meteorology, technology, and zoology*, passages in the natural sciences and technology area emphasize the significance of scientific and technological issues and advances. Natural sciences passages, which center on factual knowledge and its implications or applications, are often straightforward in their presentation since the claims they support tend to be well defined and clearly circumscribed.

### III. Cognitive Skills Assessed

The Verbal Reasoning section of the MCAT is designed to test your ability to **comprehend** information presented in a passage, **evaluate** the relationships between passage information, **apply** passage information to situations outside of the immediate scope of the passage, and **incorporate** additional information into your analysis of passage information. In this section, we describe these four different question types, give examples of each, and provide you with some suggestions or caveats to help you arrive at the best answer.

#### A. Comprehension

Comprehension questions are designed to test your ability to recognize the meaning of passage assertions. Some of these questions may ask you to identify information that is explicitly stated in the passage, some questions may ask you to draw valid inferences from passage information, and others may ask you to compare distinct ideas that are presented in the passage. In all cases, however, the emphasis is on your comprehension of the information provided in the passage.

A common comprehension question asks you to identify the central argument, concern, or thesis of the passage. To do so, read the entire passage carefully, paying close attention to how the author has chosen to structure the passage. There is no simple formula you can use to identify the main idea, but it can be helpful to ask yourself the following questions:

- Is there a central argument presented early in the passage that the author supports with subsequent information?
- Does the author conclude the passage with a claim that incorporates earlier passage information?
- Does the body of the passage provide several examples that all support a common claim?

While these questions may not lead you directly to the passage's main idea, they can provide you some insight into what the author may have been thinking when writing the passage.

Of course, there are always caveats. Some sentences that look like summaries of main ideas—for example, sentences late in the passage that begin with words such as *therefore*, *thus*, *in conclusion*—often will address only a minor or tangential point in the passage and should not be mistaken for the broader “main idea.”

On the other hand, some comprehension questions will have a narrower focus and will ask you to identify the relationship between two concepts, such as how certain passage information supports other passage information. With questions of this type, the relationship between the items in the question is often explicitly spelled out. This does not mean that the material doing the supporting and the idea being supported are necessarily mentioned near each other in the passage, but the relationships are mentioned in the passage. Comprehension questions of this type are testing your ability to recognize this.



Other common types of comprehension questions will ask you to do one of the following:

- determine, from context, the meaning of significant terminology or vocabulary used in the passage
- recognize a theory that is implicit in the passage
- identify an unstated assumption made by the passage author
- determine an appropriate paraphrase of complex passage information
- recognize a comparative relationship among ideas or pieces of information in the passage sample

A somewhat different sort of comprehension question asks you to identify appropriate questions of clarification. To put it another way, these questions ask you to identify gaps in the passage author's explanation or argument and to recognize what information is needed to fill those gaps.

## B. Evaluation

Evaluation questions—which focus primarily on your ability to identify the relationships between concepts in the passage (such as consistent, relevant, or supporting relationships) and your ability to assess the accuracy, reliability, or credibility of a claim or a source of information—differ from comprehension questions in that the information you are asked to provide is not explicitly mentioned in the passage. You need to read carefully and assess the information provided in the passage with rational analysis. For example, these questions will often direct your attention to an argument or step of reasoning in the passage and then ask you to assess the plausibility of that argument or logic of that step of reasoning.

When approaching these questions, it is important to remember that you are not being asked to provide your opinion. In other words, you may in fact disagree with a conclusion that the author reaches in the passage, even if that conclusion is a reasonable inference from the other passage information. Keep in mind that you are not to base your answers on anything other than the information provided in the passage and the information provided in the questions themselves. You may know of some reason outside of the scope of the passage that makes one of the author's conclusions unreasonable or implausible, but you need to make sure that your answers to evaluation questions—as with all Verbal Reasoning questions—are not based on any information outside of the passage or the question. Other evaluation questions will ask you to judge the credibility of a source of information in the passage.

Because all of the information needed to answer Verbal Reasoning questions is found either in the passage or in the question itself, you need to look for clues in the passage that will give you an objective basis for **making assessments of credibility**. A **credible source** is usually **someone** who has **specific expertise in the area** about **which he or she is speaking**. This may be indicated in the passage by the person's title, level of education, or specific research that he or she has conducted. A less credible source may not have any stated background that would equip him or her to address the topic knowledgeably. Or if the passage indicates that the source has a

vested interest in the situation—that is, if that person has some bias about the subject—you may think that the source is less credible.

Many evaluation questions ask you to assess the logic of an argument used by the passage author or other people in the passage. Sometimes this will take the form of asking you to identify possible alternative conclusions that can be drawn from passage information. At other times these questions will ask you to evaluate the strength of the evidence provided for a generalization, conclusion, or claim, or to judge the relevance of passage information to an argument or claim.

One of the most common evaluation questions may ask you to distinguish between passage claims that are supported by other information in the passage and those claims which are not so supported. These questions are asking you to identify logical relationships between concepts, independent of how close they appear to each other in the passage. For example, an assertion may be made in one part of the passage, but the author does not support it until much later.

A final common type of evaluation question asks you to infer an attitude, belief, or intention of the author on the basis of passage assertions or word choice. These questions can often be answered by evaluating the tone of the passage. If the passage author frequently refers to some person, idea, or subject in unflattering terms, then you can generally assume that the author disapproves of that person or those things. Usually, though, the author's opinion is derived from subtle, but consistent, treatment of some person, idea, or subject using either a positive or negative tone. These questions will often ask you outright what the author's likely opinion is, and sometimes they will ask what the author most likely meant by using a certain example or figure of speech.

### C. Application

Application questions require you to apply your understanding of the passage information to situations, real or hypothetical, outside the immediate scope of the passage. In these questions, as in all Verbal Reasoning questions, it is important to select which option is the most likely based on the information provided. It is possible that the information presented in the question when combined with passage information will result in several probable outcomes. In these situations, first eliminate any options that lead to improbable outcomes. Then try to determine which of the remaining probable outcomes is the most likely when compared to the other answer options. This may, at times, seem as though you are selecting between subtle shades of difference, but be assured that each question has one answer option that is definitely more likely than the others.

Of the four categories of Verbal Reasoning questions, application questions probably have the most variability in their appearance. Because they present additional material, these questions can come in a countless number of different forms. They will sometimes give you some new information and ask you to determine what conclusion should be drawn from this additional information when combined with the passage. In other instances, these questions may ask you to identify which of the following answer options the passage author would most likely support or most likely agree with on the basis of passage information. Other application questions may provide you with a real or hypothetical scenario and ask you to determine, on the basis of passage information, the most likely cause of that scenario. Still others may ask you to apply a passage concept to real world situations or to determine the scope of a passage concept.

No matter the form an application question takes, all ask you in some way to apply your understanding of the passage to situations similar to—but beyond the scope of—the passage itself. It is important to remember to base your answers on the information given in the passage and in the question. You may come across situations in which you believe, on the basis of your own knowledge outside of the test, that the author would not agree with something, that a term is not appropriately applied to certain situations, or that a result may not be what the passage suggests. Remember that when you approach a Verbal Reasoning question, you are limited to the world of the passage and the question, whether you agree with it or not.

## D. Incorporation of Information

Incorporation of information questions ask you to reevaluate passage assertions on the basis of new information, true or hypothetical, that is introduced in the question itself. Unlike application questions that ask you how the new information is affected by the information in the passage, incorporation of information questions ask you to determine what modifications might be necessary in the passage in light of this novel element.

These questions usually state some fact or hypothetical statement and ask you what relationship this new information has to other information in the passage. These questions often will ask whether the new information supports, fails to support, or is consistent with other information in the passage. Remember that in situations in which, for example, more than one of the options provides support for other passage information, you need to pick the option that provides the most support (or is the most consistent, or provides the least support, depending on the question type).

A common incorporation of information item asks you to identify which of the answer options would most challenge or would most weaken claims, hypotheses, arguments, or assertions made in the passage. Another type of incorporation of information question tests your understanding of the affect that additional information has on the passage in a different way. Rather than asking you whether the new information weakens, supports, or is consistent with the passage, these questions ask how the author's argument or how other information in the passage should be modified so that it could be made consistent with the new information. These questions can come in a variety of forms. They may ask whether a passage argument would need to be modified to be made consistent with the new information, but most often they ask which of the following modifications would be most appropriate.

When approaching these questions, it is important to identify the relevant detail that the question hinges upon. The information provided in an incorporation of information question usually will be consistent with some, or perhaps most, of the information in the passage. You need to be able to identify what specifically in the passage argument is least consistent with the new information, and identifying it will lead you to the part of the argument that most needs to be modified in light of the new information.

Incorporation of information questions may occasionally take a different approach and ask which of the answer options provided most resembles or is most analogous to a situation or argument that is presented in the passage. For these questions, it is important to identify the

relevant detail of the analogy. Ask yourself whether some of the items are of a similar type or represent an action or an approach to a problem similar to one in the passage? Often it is helpful to first compare the provided answer options with each other, asking yourself how they resemble each other, and in what respects they are different. Analyzing how the answer options relate to one another may help you determine the relevant detail of the analogy.

A similar type of incorporation of information question will ask you to recognize a plausible alternative to a passage hypothesis or solution. These questions usually require you to determine whether some information that supports one theory in the passage may also work well as support for an alternate theory that is not considered in the passage.

#### **IV. Introduction to Practice Sets for Verbal Reasoning**

Although the cognitive classifications we test in VR differ from those in the two science sections and there is no real “content” to test, our approach to the practice sets that follow is the same. Please see page 86 if you’d like a refresher before you begin.

# **EXHIBIT C**

**MCAT<sup>®</sup> Release Form**  
**for the State of New York**  
**(Form administered on January 23, 2015)**

**December 2017**

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**SUPPLEMENTAL MATERIAL**  
**For Physical Sciences and Biological Sciences Sections**

### Supplemental Material for Physical Sciences and Biological Sciences Sections

When students take the Physical and Biological Sciences sections, they have access to a Periodic Table of the Elements. They can access this table by clicking a tab on their computer screen. A copy of this table can be found below.

Periodic Table of the Elements																	2 He 4.0	
1 H 1.0												5 B 10.8	6 C 12.0	7 N 14.0	8 O 16.0	9 F 19.0	10 Ne 20.2	
3 Li 6.9	4 Be 9.0												13 Al 27.0	14 Si 28.1	15 P 31.0	16 S 32.1	17 Cl 35.5	18 Ar 39.9
11 Na 23.0	12 Mg 24.3																	
19 K 39.1	20 Ca 40.1	21 Sc 45.0	22 Ti 47.9	23 V 50.9	24 Cr 52.0	25 Mn 54.9	26 Fe 55.8	27 Co 58.9	28 Ni 58.7	29 Cu 63.5	30 Zn 65.4	31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 79.9	36 Kr 83.8	
37 Rb 85.5	38 Sr 87.6	39 Y 88.9	40 Zr 91.2	41 Nb 92.9	42 Mo 95.9	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3	
55 Cs 132.9	56 Ba 137.3	57 La* 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)	
87 Fr (223)	88 Ra (226)	89 Ac† (227)	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (277)	109 Mt (268)	110 Ds (281)	111 Uuu (272)	112 Uub (285)		114 Uuq (289)		116 Uuh (289)			

*	58 <b>Ce</b> 140.1	59 <b>Pr</b> 140.9	60 <b>Nd</b> 144.2	61 <b>Pm</b> (145)	62 <b>Sm</b> 150.4	63 <b>Eu</b> 152.0	64 <b>Gd</b> 157.3	65 <b>Tb</b> 158.9	66 <b>Dy</b> 162.5	67 <b>Ho</b> 164.9	68 <b>Er</b> 167.3	69 <b>Tm</b> 168.9	70 <b>Yb</b> 173.0	71 <b>Lu</b> 175.0
†	90 <b>Th</b> 232.0	91 <b>Pa</b> 231.0	92 <b>U</b> 238.0	93 <b>Np</b> (237)	94 <b>Pu</b> (244)	95 <b>Am</b> (243)	96 <b>Cm</b> (247)	97 <b>Bk</b> (247)	98 <b>Cf</b> (251)	99 <b>Es</b> (252)	100 <b>Fm</b> (257)	101 <b>Md</b> (258)	102 <b>No</b> (259)	103 <b>Lr</b> (262)

## **PHYSICAL SCIENCES SECTION**

## Physical Sciences

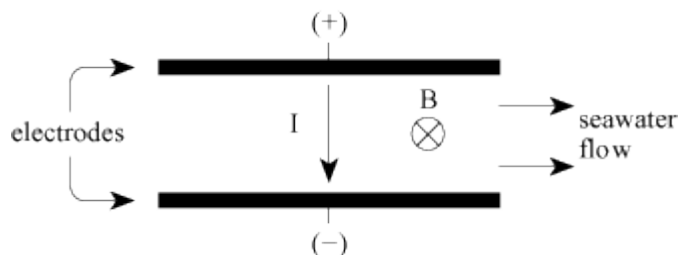
Questions 1 – 42

**DIRECTIONS:** Most questions in the Physical Sciences test are organized into groups, each preceded by a descriptive passage. After studying the passage, select the one best answer to each question in the group. Some questions are not based on a descriptive passage and are also independent of each other. You must also select the one best answer to these questions. If you are not certain of an answer, eliminate the alternatives that you know to be incorrect and then select an answer from the remaining alternatives. Indicate your selection by clicking on the answer bubble next to it. A periodic table is provided for your use. You may consult it whenever you wish.



**Passage I (Questions 1-5)**

One of the innovations in propulsion mechanisms for ocean liners is based on replacing conventional propellers by a device that uses magnetic fields in liquid propulsion systems. Such devices are called *magnetohydrodynamic* (MHD) *thrusters*, and an array of them is placed on each side of a ship's bottom.



**Figure 1** Thruster tube showing directions of current, magnetic field, and seawater flow

The construction of a thruster consists of a very strong magnet that surrounds a tube through which the seawater flows (Figure 1). The magnet is positioned so that its magnetic field is perpendicular to the length of the tube and hence perpendicular to the direction in which the water flows through the tube. Inside the tube are placed electrodes, which produce a current across the tube by moving the salt ions present in the seawater. The geometry is such that the directions of the ionic current, of the magnetic field, and of the direction of the water flow through the tube are all mutually perpendicular. Such an arrangement imposes a force that ejects the seawater from the tube, thereby producing a reaction force that propels the boat.

It is expected that with some refinements, MHD systems will allow ships to travel at top speeds of 100 km/h, with relatively low noise compared to propeller-based systems. Furthermore, due to the absence of rotating parts, the maintenance of MHD systems will be easier.

**[Questions 1-5 for Passage I begin on following page.]**

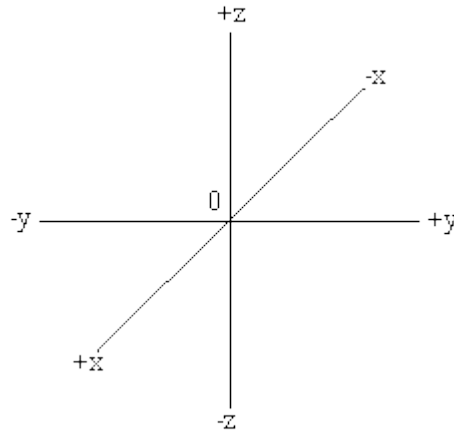
1. If  $B$  is the magnitude of the magnetic field and  $v$  is the speed of an ion of charge  $q$  (moving at a right angle to  $B$ ), then which of the following expressions gives the magnitude of the force  $F$ ?

- A)  $F = qvB$
- B)  $F = qv/B$
- C)  $F = q/(vB)$
- D)  $F = 1/(qvB)$

2. If the angle between the direction in which the ions flow across the tube and the direction of the magnetic field is  $\theta$ , then the Lorentz force is proportional to which of the following?

- A)  $\cos \theta$
- B)  $\sin \theta$
- C)  $\tan \theta$
- D)  $\theta$

3. Suppose that an electron is moving along the  $+x$  axis in a magnetic field that points along the  $+y$  axis. What is the direction of the force on the electron?



- A)  $-x$  axis
- B)  $-y$  axis
- C)  $-z$  axis
- D)  $+z$  axis

---

**4. Magnetic fields are often pictorially represented by magnetic field lines. Which of the following statements about field lines and field strength is accurate?**

- A) The closer the field lines are, the greater the magnitude of the magnetic field.
- B) The normal to the field lines is related to the magnitude of the magnetic field.
- C) The tangent to the field lines is related to the magnitude of the magnetic field.
- D) The closer the field lines are, the smaller the magnitude of the magnetic field.

**5. The resistivity of seawater is  $\rho = 0.2 \, \Omega \cdot \text{m}$ . What is the resistance between the electrodes if each is  $2 \, \text{m}^2$  in area and they are  $0.5 \, \text{m}$  apart?**

- A)  $0.05 \, \Omega$
  - B)  $0.2 \, \Omega$
  - C)  $0.5 \, \Omega$
  - D)  $2 \, \Omega$
-

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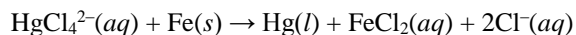
**Passage II (Questions 6-9)**

Mercury(II) sulfide (HgS) is precipitated as K106 waste material from the wastewater of many chlor-alkali plants. HgS is very insoluble in water. The EPA-designated thermal treatment of K106 waste sludge by retorting or roasting is expensive. The cheaper REMERC process involves leaching HgS in a hypochlorite ( $\text{OCl}^-$ ) environment with subsequent recovery of mercury from the leach solution either by cementation on iron or by aqueous-phase electrolysis.

The leach reaction for HgS is shown in Equation 1.

**Equation 1**

The reaction involved in mercury recovery by cementation is shown in Equation 2.

**Equation 2**

Adapted from L. G. Twidwell and R. J. Thompson, "Recovering and Recycling Hg from Chlor-Alkali Plant Wastewater Sludge." ©2001 by the Minerals, Metals, and Materials Society.

**[Questions 6-9 for Passage II begin on following page.]**

**6. None of the reactants and products in the reaction shown in Equation 1 contains:**

- A) an alkali metal.
- B) an alkaline earth metal.
- C) a nonmetal.
- D) a transition metal.

**7. Given that HOCl is a weak acid, an aqueous NaOCl solution would most likely have a pH value that is:**

- A) less than 0.
- B) greater than 0 but less than 7.
- C) equal to 7.
- D) greater than 7.

**8. Which of the following is(are) the reducing agent(s) in the reactions shown in equations 1 and 2?**

- A)  $\text{Cl}^-$  in both reactions
- B)  $\text{Cl}^-$  and Fe, respectively
- C)  $\text{S}^{2-}$  and  $\text{Cl}^-$ , respectively
- D)  $\text{S}^{2-}$  and Fe, respectively

**9. The percent by mass of Cl in NaOCl is closest to which of the following?**

- A) 30%
  - B) 40%
  - C) 50%
  - D) 60%
-

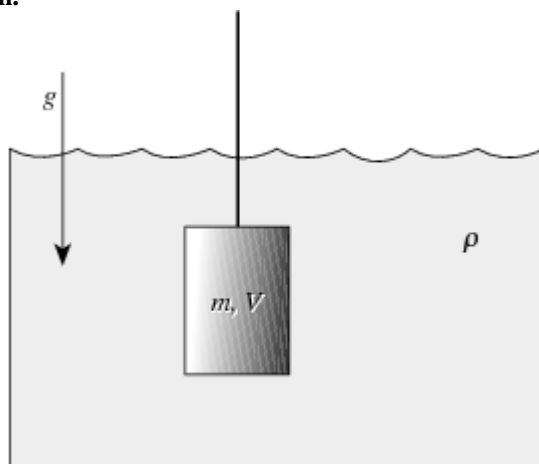


Questions 10-14 are NOT related to a passage.

10. Which of the following expressions best describes Henry's law, which relates the solubility  $S$  of a gas to its partial pressure  $P$  above the solution? (Note:  $k_H$  represents Henry's law constant for the gas.)

- A)  $S = k_H P$
- B)  $S = k_H P^{-1}$
- C)  $S = k_H P^2$
- D)  $S = k_H P^{1/2}$

11. A cylinder (mass  $m$  and volume  $V$ ) is suspended at rest from a string while immersed in water (density  $\rho$ ) on Earth (gravity  $g$ ) as shown.



Which of the following is the correct expression for the string's tension?

- A)  $mg + V\rho g$
- B)  $mg - V\rho g$
- C)  $Vg - (mg/\rho)$
- D)  $(V\rho g/m) - mg$

12. Which of the following molecules is nonpolar?

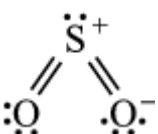
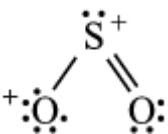
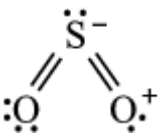
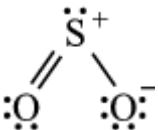
- A)  $\text{CHCl}_3$
- B)  $\text{CO}$
- C)  $\text{BF}_3$
- D)  $\text{NH}_3$

---

13. Which of the following compounds contains the bond with the most ionic character?

- A) KF
- B) KCl
- C) KBr
- D) KI

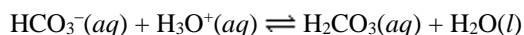
14. Which of the following is a resonance form of  $\text{SO}_2$ ?

- A) 
  - B) 
  - C) 
  - D) 
-

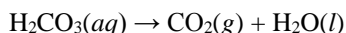
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**Passage III (Questions 15-19)**

The bicarbonate ion,  $\text{HCO}_3^-$ , is a weak base. As such, it is used in antacid preparations to neutralize excess stomach acid, as in Reaction 1.

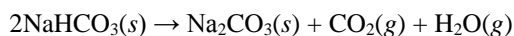
**Reaction 1**

Carbonic acid is unstable and tends to decompose according to Reaction 2.

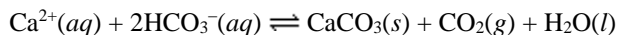
**Reaction 2**

A mixture of carbonic acid and bicarbonate ion constitutes a buffer, which plays an important role in human body chemistry. One function is to maintain blood at a slightly alkaline pH.

Sodium bicarbonate,  $\text{NaHCO}_3$ , is commonly known as baking soda. During baking, it decomposes, releasing carbon dioxide (Reaction 3) and causing the dough to rise.

**Reaction 3**

Bicarbonates are present in water due to the dissolution of carbon dioxide. If the water also contains cations such as  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ , and  $\text{Fe}^{2+}$ , as is the case with “hard” water, insoluble carbonates can be formed upon heating (Reaction 4), causing deposits on the inner walls of pipes or water heaters.

**Reaction 4**

The water softening process usually involves the removal of  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ , and  $\text{Fe}^{2+}$  ions and their replacement by  $\text{Na}^+$  ions. In this way, precipitate formation is minimized, as  $\text{Na}_2\text{CO}_3$  is a highly soluble compound.

**[Questions 15-19 for Passage III begin on following page.]**

15. Which of the following atoms will be expected to have the smallest second ionization energy?

- A) Na
- B) C
- C) O
- D) Ca

16. Which of the following species has the largest mass percent of oxygen?

- A)  $\text{H}_2\text{O}$
- B)  $\text{CaCO}_3$
- C)  $\text{CO}_2$
- D)  $\text{HCO}_3^-$

17. What is the pH of a buffer solution which is 0.2 M in  $\text{HCO}_3^-$  and 2 M in  $\text{H}_2\text{CO}_3$ ? (The first  $\text{p}K_a$  of carbonic acid is 6.37.)

- A) 4.37
- B) 5.37
- C) 6.37
- D) 7.37

18. What is the concentration of  $\text{Ca}^{2+}(aq)$  in a saturated solution of  $\text{CaCO}_3$ ? (The solubility product constant  $K_{sp}$  for  $\text{CaCO}_3$  is  $4.9 \times 10^{-9}$ .)

- A)  $4.9 \times 10^{-5} \text{ M}$
- B)  $7.0 \times 10^{-5} \text{ M}$
- C)  $24.5 \times 10^{-5} \text{ M}$
- D)  $4.9 \times 10^{-9} \text{ M}$

---

19. The values of heats of formation  $\Delta H_f^\circ$  for participants in Reaction 3 are listed below.

Compound	$\Delta H_f^\circ$ , kcal/mol
$\text{NaHCO}_3(s)$	-230
$\text{Na}_2\text{CO}_3(s)$	-270
$\text{H}_2\text{O}(g)$	-60
$\text{CO}_2(g)$	-90

What is the standard heat of reaction  $\Delta H^\circ$  for Reaction 3?

- A) -40 kcal/mol  
B) -190 kcal/mol  
C) 40 kcal/mol  
D) 190 kcal/mol
-

Questions 20-21 are NOT related to a passage.

**20. Which of the following combinations describes the most favorable heat of reaction and entropy change for spontaneous chemical reactions?**

- A) Heat is absorbed and entropy increases.
- B) Heat is absorbed and entropy decreases.
- C) Heat is emitted and entropy increases.
- D) Heat is emitted and entropy decreases.

**21. Gamma decay occurs when a nucleus emits:**

- A) a photon.
  - B) a proton.
  - C) a neutron.
  - D) an electron.
-



---

**Passage IV (Questions 22-26)**

Ultrasound is well known as a diagnostic imaging tool, but a new use is now emerging. Cancer researchers are investigating how focused ultrasound can aid in performing surgeries. Focused ultrasound surgery (FUS) has promise as a means of destroying cancer cells deep within the body.

The idea is straightforward. For example, imaging reveals the location of cancerous cells within an organ, such as the liver. A transducer (shaped as a sector of a spherical shell) that emits ultrasound is placed against the body and coupled to the skin with degassed water. The focal length of the transducer is then adjusted to focus the ultrasound energy into the liver's tumor, and the focused ultrasound energy elevates the temperature in the tumor to destroy the cancer cells. One transducer currently used has a focal length of 15 cm.

The intensity of 1.5 MHz ultrasound is about  $1500 \text{ W/cm}^2$  at the focus of the beam. This raises the temperature of the tissue by the required  $20^\circ\text{C}$  to  $30^\circ\text{C}$  that is needed to kill the cancerous tissue. Typically, exposure times must be only from 1 to 3 seconds, as the rate of temperature increase is about  $70^\circ\text{C/s}$ . The heat absorbed is directly proportional to the intensity emitted by the transducer.

Of course, the tissue that the ultrasound passes through absorbs some of the beam's energy. If a traveling wave has intensity  $I_0$  at the origin, it has intensity at a distance  $x$  into the tissue of  $I = I_0 e^{-\mu x}$ , where  $\mu$  is an attenuation coefficient whose value depends on the properties of the tissue. This must be taken into account in estimating the necessary intensity emitted by the transducer.

**[Questions 22-26 for Passage IV begin on following page.]**

**22. A transducer has a focal length of 15 cm. If it is placed in contact with the skin, approximately how far below the skin will cells be heated the most?**

- A) 5.0 cm
- B) 7.5 cm
- C) 15 cm
- D) 30 cm

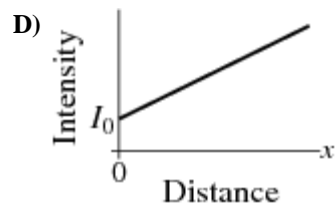
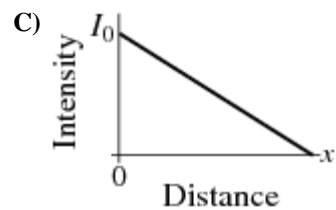
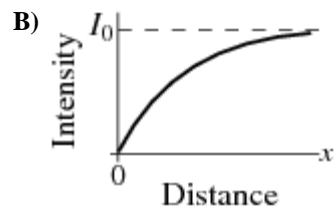
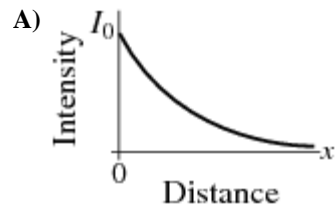
**23. Based on the passage, at what depth in the body will the intensity of the ultrasound decrease to  $1/e$  of the intensity that enters the body?**

- A)  $\mu$
- B)  $e/\mu$
- C)  $\mu /(\ln 2)$
- D)  $1/\mu$

**24. Approximately how long must a tumor be exposed to ultrasound at an intensity of  $1500 \text{ W/cm}^2$  in order to raise the tumor's temperature by approximately  $35^\circ\text{C}$ ?**

- A) 0.50 s
- B) 0.75 s
- C) 1.00 s
- D) 1.50 s

25. Based on the passage, which of the following plots best represents the intensity of the ultrasound versus the distance  $x$  that the pulse has traveled into the body?



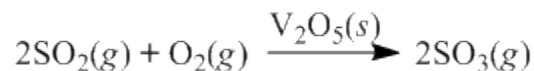
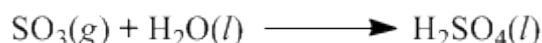
26. Doubling the frequency of the sound waves the transducer emits would:

- A) double the wavelength of the sound waves in the body.
- B) double the speed of the sound waves in the body.
- C) halve the amplitude of the sound waves entering the body.
- D) halve the time period of the sound waves emitted by the transducer.

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**Passage V (Questions 27-32)**

A catalyst is a substance that speeds up a reaction without being consumed. For example,  $\text{V}_2\text{O}_5$  is used as a catalyst to oxidize  $\text{SO}_2$  to  $\text{SO}_3$  in the first step of the production of sulfuric acid (reactions 1 and 2).

**Reaction 1****Reaction 2**

Furthermore,  $\text{H}_2\text{O}_2$  can be decomposed with the aid of a catalyst, as shown in reactions 3 and 4.

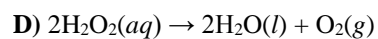
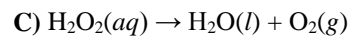
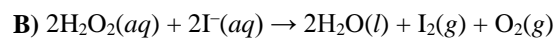
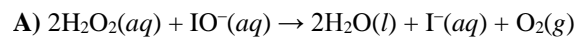
**Reaction 3****Reaction 4**

Catalysts are widely utilized in automobile catalytic converters, where the exhaust gases are passed through beads of a solid catalyst. The catalyst aids in the conversions of carbon monoxide to carbon dioxide, hydrocarbons to carbon dioxide and water, and nitric oxide to nitrogen gas. Unfortunately, catalytic converters also can catalyze the oxidation of  $\text{SO}_2$  to  $\text{SO}_3$ , which subsequently reacts with moisture to form unwanted sulfuric acid.

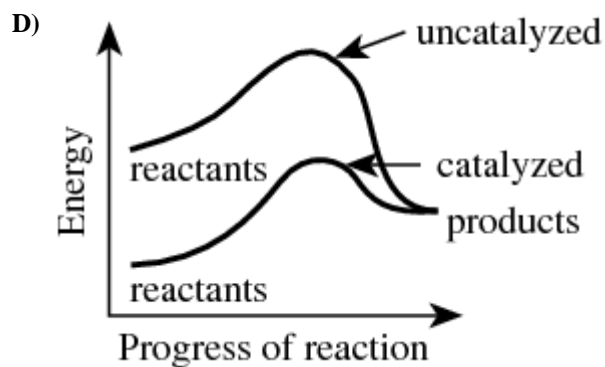
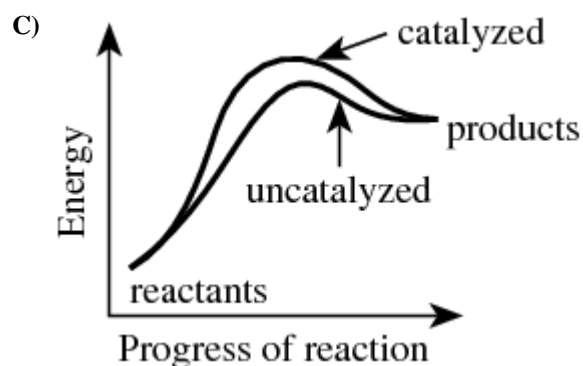
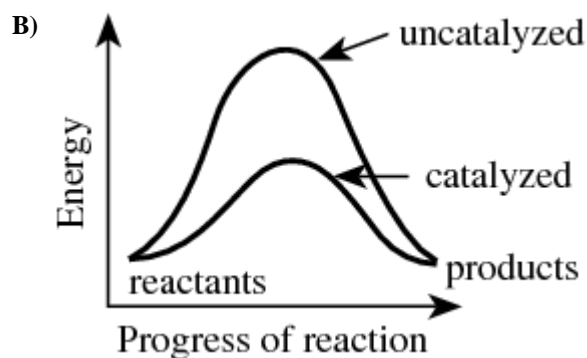
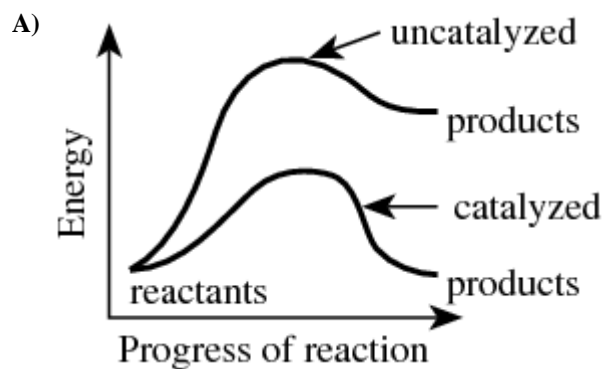
Catalysts are classified as either *homogeneous* or *heterogeneous*. A homogeneous catalyst exists in the same phase as the reactant molecules, whereas a heterogeneous catalyst exists in a different phase than the reactants.

[Questions 27-32 for Passage V begin on following page.]

**27. Which of the following is the overall reaction for the decomposition of  $\text{H}_2\text{O}_2$  that is shown in reactions 3 and 4?**



28. Which of the following energy profiles *best* illustrates the difference between catalyzed and uncatalyzed reactions?





---

29. Which of the following diagrams does NOT illustrate a function of an automobile catalytic converter?

- A)  $\text{CH}_4 \rightarrow \text{converter} \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$
- B)  $\text{CO} \rightarrow \text{converter} \rightarrow \text{CO}_2$
- C)  $\text{SO}_3 \rightarrow \text{converter} \rightarrow \text{SO}_2 + \text{H}_2\text{O}$
- D)  $\text{NO} \rightarrow \text{converter} \rightarrow \text{N}_2$

30. Which of the following most likely will occur if a homogeneous catalyst CANNOT be separated from the products at the end of a reaction?

- A) The catalyst will become heterogeneous.
- B) The products will be contaminated.
- C) The reaction will not occur.
- D) The reaction rate will speed up.

31. How will the rate of a catalyzed reaction be affected if the solid catalyst is finely ground before it is added to the reaction mixture?

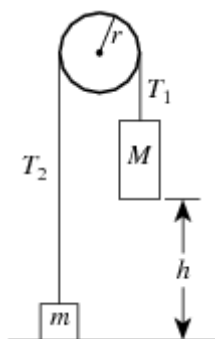
- A) The rate will be faster because a greater mass of catalyst will be present.
- B) The rate will be faster because a greater surface area of catalyst will be exposed.
- C) The rate will be slower because the fine catalyst particles will interfere with product formation.
- D) The rate will remain the same because the mass of catalyst will be the same.

32. Which of the following substances is(are) catalyzing the decomposition of  $\text{H}_2\text{O}_2$  as it is shown in reactions 3 and 4?

- A)  $\text{I}^-(aq)$  only
- B)  $\text{I}^-(aq)$  and  $\text{IO}^-(aq)$  only
- C)  $\text{IO}^-(aq)$  only
- D)  $\text{O}_2(g)$  only
-

**Passage VI (Questions 33-39)**

In his 1784 book, George Atwood published a simple model for teaching Newton's laws and conservation of energy concepts. Called the *Atwood machine*, the simplest form of the model has two masses connected by a massless, unstretchable string and hung vertically over a massless pulley as in Figure 1.

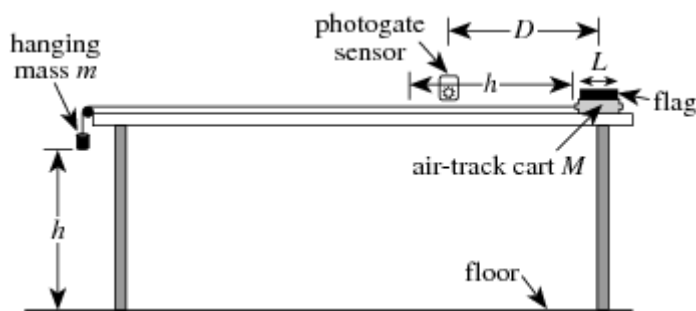


**Figure 1** Simple Atwood machine

If the masses in Figure 1 are equal, they do not accelerate; but if the masses are unequal, the difference in their weights equals the net force on the system, causing the total mass to accelerate uniformly at a rate

$$a = \frac{M - m}{M + m} g$$

A variation of the Atwood machine has an air-track cart on a frictionless, linear air track (Figure 2), and a second, hanging mass that falls a distance  $h$  to the ground, which accelerates the air-track cart.



**Figure 2** Air-track apparatus

Theoretical values for the acceleration in a typical setup of Figure 2 are given in Table 1.

**Table 1** Predicted Cart Acceleration vs Hanging Mass

Hanging mass (kg)	Additional load in cart (kg)	Predicted cart acceleration ( $\text{m/s}^2$ )
0.02	0.08	0.5
0.04	0.06	1.0
0.06	0.04	1.5
0.08	0.02	2.0
0.10	0.00	2.5

The acceleration of the cart  $a$  can be determined from the cart's speed  $v$ , which in turn is determined via a *photogate timer*. The photogate emits an infrared beam to a sensor on the other side of the gate. The metal flag on top of the cart blocks the photogate's infrared beam, which lets a connected timer run while the beam is blocked. The speed  $v$  is then estimated by  $v = L/t$  and  $a$  is calculated from  $a = v^2/(2D)$ .

(Assume  $g$  is  $10 \text{ m/s}^2$ .)

[Questions 33-39 for Passage VI begin on following page.]

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33. Based on Figure 1, which of the following expressions is closest to the speed of  $m$  when  $M$  has fallen a distance  $h$ ?

A) 
$$v = \sqrt{\frac{Mgh - mgh}{m}}$$

B) 
$$v = \sqrt{\frac{Mgh + mgh}{m}}$$

C) 
$$v = \sqrt{\frac{2(Mgh + mgh)}{M + m}}$$

D) 
$$v = \sqrt{\frac{2(Mgh - mgh)}{M + m}}$$

34. In the simple Atwood machine of Figure 1, the pulley wheel has zero mass; if  $M > m$ , then the system accelerates with a linear acceleration  $a$ . In reality, the pulley wheel has mass and rotational inertia, so the actual acceleration is:

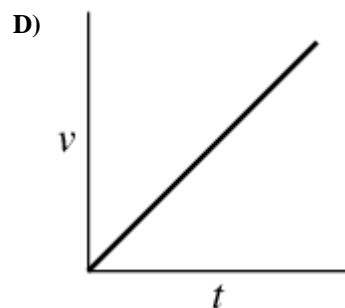
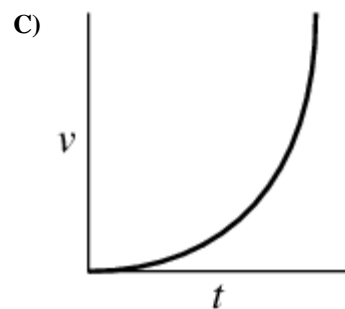
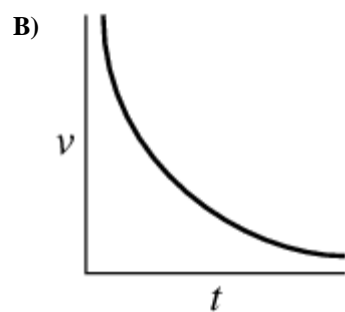
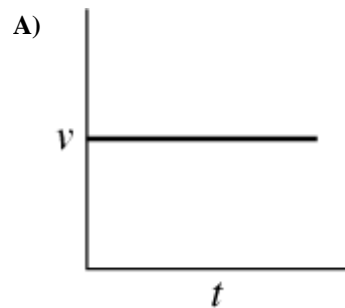
A) less than  $a$ , and  $T_1$  is less than  $T_2$ .

B) less than  $a$ , and  $T_1$  is greater than  $T_2$ .

C) still equal to  $a$ , but  $T_1$  is less than  $T_2$ .

D) still equal to  $a$ , but  $T_1$  is greater than  $T_2$ .

35. Ignoring air resistance, which of the following graphs best represents the speed of the cart in Figure 2 as a function of time for the cart *after* the hanging mass hits the floor?



---

**36. Assume that the air track in Figure 2 is modified so that the end where the cart starts is raised up, tilting the track at a slight angle to the horizontal. Before the string is attached to the cart and the air is turned on, consider that the free-body diagram of the cart at rest includes three forces: its weight, the normal force, and friction. Which of these, if any, is the greatest in magnitude?**

- A) Weight
- B) Normal force
- C) Friction
- D) All three forces are equal.

**37. Given that the acceleration of gravity on the Moon's surface is about  $1/6$  of that on the Earth's surface, the expected values of the cart's acceleration from Table 1 on the Moon would be about:**

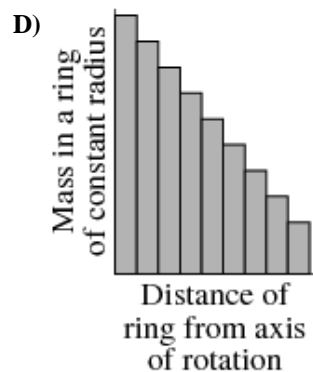
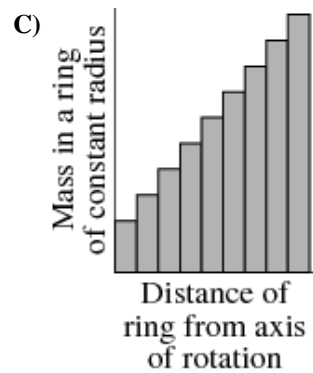
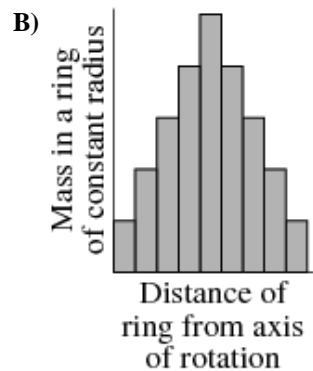
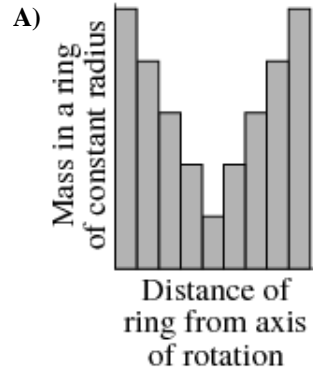
- A)  $1/36$  of the Earth values.
- B)  $1/6$  of the Earth values.
- C) the same as the Earth values.
- D) 6 times the Earth values.

**38. Assuming the air track in Figure 2 is NOT functioning, which of the following is closest to the static friction force holding the cart in place when the hanging mass in Table 1 is 0.10 kg?**

- A) 1 N
- B) 2 N
- C) 3 N
- D) 4 N



39. Given a constant total mass for the pulley in Figure 2, which of the following graphs shows the radial distribution of pulley mass (outward from the axle) that will *minimize* the differences between the actual cart accelerations and the theoretical values in Table 1?



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Questions 40-42 are NOT related to a passage.

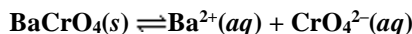
40. Which of the following assumptions is necessary in order to apply Bernoulli's equation correctly to a fluid moving through a cylindrical pipe?

- A) The pipe is horizontal.
- B) The fluid is nonviscous.
- C) The diameter of the pipe is constant.
- D) The velocity of the fluid is constant.

41. When a human eye with 20/20 vision forms a sharp image of a distant object on its retina, the distance between the eye lens and the retina is equal to:

- A) the aperture of the lens.
- B) the focal length of the lens.
- C) twice the focal length of the lens.
- D) about 2 mm.

42. The equilibrium



exists in a saturated aqueous solution of BaCrO<sub>4</sub>. Dissolution of Na<sub>2</sub>CrO<sub>4</sub> in a saturated aqueous BaCrO<sub>4</sub> solution would:

- A) have no effect on the position of this equilibrium.
- B) shift this equilibrium left.
- C) shift this equilibrium right.
- D) shift this equilibrium first right and then left.

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**End of Physical Sciences Section**

**Physical Sciences Answer Key**

Question Number	Answer Key
1	A
2	B
3	C
4	A
5	A
6	B
7	D
8	D
9	C
10	A
11	B
12	C
13	A
14	D
15	D
16	A
17	B
18	B
19	C
20	C
21	A
22	C
23	D
24	A
25	A
26	D
27	D
28	B
29	C
30	B
31	B
32	A
33	D
34	B
35	A
36	A
37	B
38	A
39	D
40	B
41	B
42	B

**Physical Sciences Raw Score to Scale Score Conversion Table**

Raw Score	Scale Score
0	1
1	1
2	1
3	1
4	1
5	1
6	2
7	2
8	2
9	2
10	3
11	3
12	3
13	4
14	4
15	5
16	5
17	5
18	6
19	6
20	6
21	6
22	7
23	7
24	7
25	8
26	8
27	8
28	8
29	9
30	9
31	10
32	10
33	10
34	11
35	11
36	12
37	12
38	12
39	13
40	14
41	14
42	15

## **VERBAL REASONING SECTION**

## Verbal Reasoning

Questions 43 – 75

**DIRECTIONS:** There are six passages in the Verbal Reasoning test. Each passage is followed by several questions. After reading a passage, select the one best answer to each question. If you are not certain of an answer, eliminate the alternatives that you know to be incorrect and then select an answer from the remaining alternatives. Indicate your selection by clicking on the answer bubble next to it.

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**Passage I (Questions 43-47)**

The depiction of fictional violence on television deserves much less criticism than it has received in the United States. Trite or not, scenes of imaginary violence are almost always orchestrated by high production values: filled with changing camera shots, intricately edited. This finely wrought symbolic material has endured for decades because of viewers' preferences—not because of what people *say* they want but because of what they actually watch.

Perhaps, to give television violence its due, we need first to acknowledge the complex, sometimes violent content of our inner lives. Parents want to know why young children love to view violent superheroes struggling against imaginary antagonists. They make the choice because of an inner need for such turbulent content—a need that deserves to be acknowledged. Consider that to be six years old is to be essentially powerless in the world of human affairs; even turning a door handle can be a challenge. Through imaginary violence, however, the child viewer becomes momentarily omnipotent, transcending all obstacles of an oversized world.

Who opposes these experiences? Parents, of course. But it is in the halls of Congress that the attack invariably crystallizes. Nebulous concerns about video mayhem afloat among the public, plus a collection of published “scientific” studies, are forged by astute politicians into an issue of immediate concern. While many congressional items are too dull to inspire reportage, this controversy is well covered by the press, bringing the senator’s or representative’s name and image into households throughout the country. Their fame is linked to an immaculate concern—the purification of American family life. The senator or representative is depicting himself or herself as a savior, purer than pure.

Scholars play a pivotal role in this war of words: they are the munitions makers—though they would dislike the label. Granted that a close reading of their total corpus reveals little consensus, there are enough studies with the “right” findings to provide ample ammunition for reformists. These studies are taken to legitimize the assault on television programs that contain violent plots; they are cited in every attacking document and speech. Scholars promulgate the antiviolence position by arguing for it in their lectures and other public utterances and, indirectly, by not contradicting the conventional antiviolence wisdom on the topic.

On television violence, professors as a rule have been needlessly shortsighted. If they had stood back and examined television violence in its long-term historical context and seen where this matter ranks alongside the recurring atrocities in human history, then they would have realized that television violence is a relatively minor happenstance. Its appearance suggests an improvement in the human condition, not a deterioration: a harmless way of sublimating, or distancing, those normal feelings of powerlessness or anger or frustration or aggression that well-adjusted human beings vent in a civilized society through vicarious means. From such material fairy tales and folktales once originated, captivating some of the same generations that now demonstrate the most vigilance in filtering out violent content from their children’s television fare.

What can be asked for here is that the public and the scholarly community apply a high level of intellect to the issue of television violence. Both the historical and the scientific evidence need to be sorted through very carefully. We need to ask new questions and do new studies probing such questions as why some societies heavily dependent on American television programming have much lower rates of violent crime. Only then can there be a full understanding of the role of television violence in the lives of modern human beings.

Adapted from J. Fowles, *The Case for Television Violence*. ©1999 by J. Fowles.

**[Questions 43-47 for Passage I begin on following page.]**

**43. Which of the author's assertions is most susceptible to empirical verification or refutation?**

- A) Six-year-olds feel essentially powerless in the world of human affairs.
- B) Congressional members seek fame and reputations as crusaders for nonviolence.
- C) Professors lack wisdom on the issues of television violence.
- D) Scholars provide the information central to debates about television violence.

**44. Which view expressed by the author is most important for readers to share if they are to be convinced of the merits of the passage argument?**

- A) Fantasy violence is an essentially healthy experience.
- B) The taste for television violence reflects audience inadequacy.
- C) The majority of people are dishonest about violence.
- D) Professors abuse their positions as teachers.

**45. Which of the following most accurately summarizes the passage author's views on television violence in the context of public policy?**

- A) The current advocates of television violence tend to be highly biased.
- B) Public stances on television violence are affected by ulterior motives.
- C) We have good reason to believe that television violence benefits society.
- D) The presentation of imaginary violence on television is not a public policy issue.

**46. Assuming the truth of this author's understanding of widespread fantasy violence as an improvement in the human condition (paragraph 5), which behavior pattern would be LEAST consistent with that understanding? Children watching more than average amounts of television violence:**

- A) behave similarly to those who do not.
- B) exhibit more purpose and competence.
- C) exhibit greater moral courage in confronting wrongs.
- D) engage in fewer criminal activities as adults.

**47. For thousands of years, theorists have proposed alternate accounts of the functions or effects of fantasized violence. Which of the following theories would be most consistent with the central point of the passage?**

- A) The *normative*: violent retributions symbolically affirm important social values.
  - B) The *mimetic*: fantasy violence represents what actually occurs in the real world.
  - C) The *cathartic*: impulses toward real violence are dissipated through vicarious fantasies.
  - D) The *social learning*: images of fictional violence teach the use of force to solve real conflicts.
-



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**Passage II (Questions 48-54)**

A planet's magnetic field forms a link between the deep interior (where it is generated) and the space surrounding the planet, into which it reaches, often out to dozens of planetary radii. *Voyager* found strong magnetic fields at each of the four giant planets (Jupiter, Saturn, Uranus, and Neptune).

An eternal wind of charged particles, the solar wind, streams from the Sun, blowing a planet's magnetic field back like a wind sock. The boundary where the supersonic solar wind first senses a planet's magnetic field is called the *bow shock*. Closer to the planet is a second boundary, called the *magnetopause*, which marks the surface that separates the solar wind from the planet's magnetosphere.

Before the *Voyager* encounters, astronomers had no firm evidence that Uranus and Neptune even *had* magnetic fields, although they anticipated them from the results at Jupiter and Saturn. Therefore, during the early Uranus encounter, a few tense days ensued when *Voyager*'s magnetometers remained silent well past the point where a magnetic field was expected.

Finally, just ten hours before closest approach, the spacecraft crossed the telltale bow shock and the anxiety of the magnetic field investigators quickly turned to excited concentration as they began to map the Uranian magnetic field. The structure they found astonished them.

To describe a planet's magnetic field, the simplest way is to characterize it by its dipole moment, the magnetic field that a big imaginary bar magnet would have if buried deep inside the planet. This sounds oversimple, but it is actually realistic since most theories of planetary magnetism invoke a dynamo driven by the coupling of the planet's rotation to the circulation of deep, electrically conductive fluid. These theories also predict that a planet's magnetic dipole axis should tilt slightly away from the rotation axis—and this holds for Earth and Jupiter. (But not Saturn, where the field has no measurable tilt.)

The location of Uranus's dipole, however, was bizarre. Tilting more than theory called for, the Uranian dipole was also displaced, or offset, from the planet's center. Right after *Voyager*'s Uranus encounter, many scientists wrote off the tilt and offset as freaks of nature. They thought that either the large tilt related somehow to the fact that Uranus was tipped on its side, or that the Uranian magnetic field was undergoing a reversal in polarity, as has occurred on Earth in the past.

Then came Neptune. Its dipole showed a similar tilt—and an even greater offset! Thus, almost against their will, astronomers came to realize that the magnetic fields of Uranus and Neptune formed a new class unto themselves. Present thinking explains the large offsets by proposing that the magnetic fields of Uranus and Neptune are generated in their intermediate layers, not in their cores.

The unexpectedly large offsets of these two magnetic fields mean that the surface field strengths vary from place to place by a factor of ten: from a low of about 0.1 gauss to a high of about 1.0 gauss. (Earth's surface field strength is about 0.3 gauss.) Similarly, the large tilts of the two magnetic fields mean that the geometry of the field as it meets the solar wind changes continuously as Uranus and Neptune rotate. This creates a complicated, dynamic magnetosphere.

Adapted from T. Dowling, Big, blue: The twin worlds of Uranus and Neptune. ©1990 by Kalmbach Publishing Co.

**[Questions 48-54 for Passage II begin on following page.]**

**48. Which of the following best describes the passage?**

- A) It is an explanation of how magnetic fields are generated.
- B) It is a documentation of scientific observations for further study.
- C) It is a report about the magnetic fields of the giant planets.
- D) It is a refutation of a widely held theory of planetary magnetism.

**49. According to the passage, the magnetic field data received from Uranus and Neptune caused scientists to:**

- A) question the accuracy of the data.
- B) reassess their theories about Earth's magnetic fields.
- C) formulate hypotheses to explain the unexpected findings.
- D) redefine the concept of planetary magnetism.

**50. The assertion that Earth has undergone a reversal in its magnetic polarity is:**

- A) supported by data received from the *Voyager* mission.
- B) contradicted by data received from the *Voyager* mission.
- C) supported by evidence in the passage, but not by any data received from the *Voyager* mission.
- D) not supported by any evidence in the passage.

**51. Based on the passage, if the magnetic field of Uranus were measured at a random time at a random point on the surface of the planet, its strength could be:**

- I. equal to the average magnetic field strength on Earth.
- II. greater than the average magnetic field strength on Earth.
- III. less than the average magnetic field strength on Earth.

- A) II only
- B) III only
- C) I or II only
- D) I, II, or III

**52. Based on the passage, astronomers were excited when *Voyager*'s magnetometers first detected Uranus's magnetic field because:**

- A) they had not been sure Uranus had a magnetic field.
- B) they had not anticipated that Uranus had a magnetic field.
- C) Uranus's magnetic field extended farther out from the planet than they had anticipated.
- D) *Voyager* had detected no magnetic field when it passed through the bow shock.

---

**53. It is asserted in the passage that the dipole model with a large, imaginary bar magnet inside the planet is:**

- A) a very misleading representation of planetary magnetism.
- B) an oversimplification of planetary magnetism.
- C) a realistic representation of planetary magnetism.
- D) an exact representation of planetary magnetism.

**54. Based on the passage, Saturn's untilted magnetic field is:**

- A) predicted by prevailing theories of planetary magnetism.
  - B) attributable in part to Saturn's great mass.
  - C) attributable in part to Saturn's rings.
  - D) not predicted by prevailing theories of planetary magnetism.
-

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**Passage III (Questions 55-60)**

The practical ideal of democracy consists in the self-government of the masses in conformity with the decisions of popular assemblies. But while this system limits the extension of the principle of delegation, it fails to provide any guarantee against the formation of an oligarchical ruling clique. Undoubtedly it deprives the natural leaders of their quality as functionaries, for this quality is transferred to the people themselves. The crowd, however, is always subject to suggestion, being readily influenced by the eloquence of popular orators; moreover, direct government by the people, admitting of no serious discussions or thoughtful deliberations, greatly facilitates sudden insurrections of all kinds by individuals who are exceptionally bold, energetic, and adroit.

It is easier to dominate a large crowd than a small audience. The adhesion of the crowd is tumultuous, summary, and unconditional. Once the suggestions have taken effect, the crowd does not readily tolerate contradiction from a small minority, and still less from isolated individuals. A great multitude assembled within a small area is unquestionably more accessible to panic alarms, to unreflective enthusiasm, and the like than is a small meeting, whose members can quietly discuss matters among themselves.

It is a fact of everyday experience that enormous public meetings commonly carry resolutions by acclamation or by general assent, while these same assemblies, if divided into small sections, say of fifty persons each, would be much more guarded in their assent. Great party congresses, in which the elite of the membership are present, usually act in this way. Words and actions are far less deliberately weighed by the crowd than by the individuals of the little groups of which this crowd is composed. The fact is incontestable—a manifestation of the pathology of the crowd. The individual disappears in the multitude and therewith disappears also personality and sense of responsibility.

The most formidable argument against the sovereignty of the masses is, however, derived from the mechanical and technical impossibility of its realization. The sovereign masses are incapable of undertaking the most necessary resolutions. The impotence of direct democracy, like the power of indirect democracy, is a direct outcome of the influence of number.

It is obvious that a gigantic number of persons belonging to a unitary organization cannot do any practical work using a system of direct discussion. The regular holding of deliberative assemblies of a thousand members encounters the gravest difficulties in respect to room and distance; from the topographical point of view, such an assembly would become altogether impossible if the members numbered ten thousand. Even if we imagined the means of communication to become much better than those that now exist, how would it be possible to assemble such a multitude in a given place, at a stated time, and with the frequency demanded by the exigencies of political life? In addition must be considered the physiological impossibility even for the most powerful orators of making themselves heard by a crowd of ten thousand persons.

There are, however, other reasons of a technical and administrative character that render impossible the direct self-government of large groups. If Peter wrongs Paul, it is out of the question that all the other citizens should hasten to the spot to undertake a personal examination of the matter in dispute and to take the part of Paul against Peter. By parity of reasoning, in the modern democratic state, it is impossible for the collectivity to undertake the direct settlement of all the controversies that may arise.

Adapted from R. Michels, *Political Parties: A Sociological Study of the Oligarchical Tendencies of Modern Democracy*. In public domain. Published 1958 by The Free Press.

**[Questions 55-60 for Passage III begin on following page.]**

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**55. Which of the following statements from the passage most strongly indicates that the passage was written prior to the twenty-first century?**

- A) “The regular holding of deliberative assemblies of a thousand members encounters the gravest difficulties in respect of room and distance. . . .”
- B) “The crowd . . . is . . . readily influenced by the eloquence of popular orators.”
- C) “[T]hese same assemblies, if divided into small sections, . . . would be much more guarded in their assent.”
- D) “The sovereign masses are incapable of undertaking the most necessary resolutions.”

**56. Which of the following assertions in the passage does the author support with a practical example?**

- A) “[D]irect government by the people . . . greatly facilitates sudden insurrection of all kinds by individuals who are exceptionally bold, energetic, and adroit.”
- B) “[A]nd therewith disappears also personality and sense of responsibility.”
- C) “The adhesion of the crowd is tumultuous, summary, and unconditional.”
- D) “[I]t is impossible for the collectivity to undertake the direct settlement of all the controversies that may arise.”

**57. Suppose the author were asked to advise a newly independent nation about the form of government it should establish. Based on the passage, the author would probably recommend:**

- A) a monarchy, in which decisions are made by one supreme leader.
- B) a representative democracy, in which decisions are made by a limited number of elected representatives.
- C) a direct democracy, in which decisions are made by all the adults in the country.
- D) an oligarchy, in which decisions are made by a small group of capable individuals.

**58. Consider that some groups are defined as “cults”; members of these extremist religious sects generally live communally and obey an authoritarian, charismatic leader. Assume that all cults have fewer than 100 members. This information would tend to *weaken* the passage’s assertions about the:**

- A) ability of great orators to sway large groups.
- B) loss of personality and sense of responsibility.
- C) difficulties involved in convening large assemblies.
- D) reasonableness of small groups compared to large groups.

**59. When using the term “the sovereignty of the masses” (paragraph 4), the author seems to mean the ability of the masses to:**

- A) vote in elections that decide who their leaders will be.
- B) make every decision concerning their governance.
- C) discuss all the potential consequences of specific actions.
- D) understand the difference between popular orators and natural leaders.

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**60. Which of the following actions does the author seem to view in the most favorable light?**

- A) Great popular orators addressing attentive crowds
  - B) Deliberative assemblies of a thousand members holding regular meetings
  - C) Members of a group quietly discussing matters
  - D) Individuals examining the details of disputed issues
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**Passage IV (Questions 61-65)**

In the recent past, China's art academies have been not only the training grounds for most Chinese professional artists, but the source of employment and other benefits. Aside from salaries for artists and teachers, the academies provided—at least through the early 1990s—the evaluation and qualification for various scholarships and for official positions in the art world. Thus, contemporary Chinese avant-garde art movements—consisting of artists who engage in styles and forms ahead of their time—have been unable to escape the necessity of some kind of relationship with the official art academies, be it positive or negative. Taiwan's avant-garde Fifth Moon Group of the 1950s and 1960s, which inspired an abstract art movement, is an excellent example.

The Fifth Moon Group's major source of members were graduates of the Art Department of Taiwan Normal University, the bastion of the rigid orthodox tradition that, like the painting academies of China's imperial past, stressed a formal, realistic style of painting. These young standard-bearers of the new art bravely criticized traditionalist art—and since their own school represented the center of orthodox tradition, they served as serious critics. Avant-garde or not, their criticism would have been disregarded and had little, if any, effect on jolting the orthodox tradition if they had not been already a part of Taiwan's art establishment. However, the future of the avant-garde movement promoted by the Fifth Moon Group depended on its ability to win control of the university art department or to create a new mechanism for resources to support its development. Unfortunately, the Fifth Moon Group could not gain the upper hand in the university, nor did it have the means to create its own academy. Eventually the members of the group went abroad, ending hopes for reform.

This outcome did not come about by happenstance. The Chinese government has traditionally held control over the education system, and there is little room for private institutions to develop outside of government control. Both in Taiwan and in mainland China, this situation became more acute into the early 1990s. In 1979, when mainland China ended its period of cultural isolation from the West, a new wave of avant-garde art was already evident. The role played by the official art academies in the avant-garde movement in China is an interesting one.

The pioneering "Stars" exhibitions of 1979 and 1980 provide a good example. The Stars avant-garde art group competed with the orthodox art world by using forms of expression in their works unimaginable to the Chinese academy painters. The artists expressed their disillusion with the heavily propagandistic art officially sanctioned by the Communist Party through what amounted to a criticism of the "dark side" of society, including the educational system. It is important to note that the artists of the Stars group were not related to the art academies but rather were a group of amateur painters. This amateur status not only allowed them to avoid the stylistic and thematic restrictions imposed by the art academies, it also freed them to work to overturn the orthodox, having no vested interest in maintaining it. On the other hand, they also faced many disadvantages, the greatest being the need to overcome the constraints placed by the academies over the control of the socioeconomic resources for art. The result was that the Stars' resources were cut off and the members eventually went their separate ways, leaving China to find a new space in which to develop: the same fate that had befallen Taiwan's Fifth Moon Group.

Adapted from S. Shih, *The orthodox and the avant-garde: an historical examination*. ©1993 by Hanart T Z Gallery.

**[Questions 61-65 for Passage IV begin on following page.]**

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**61. Based on the passage, if Taiwan's Fifth Moon Group were to have flourished and taken control of the Taiwan Normal University Department, which of the following would most likely have resulted in subsequent years?**

- A) The academy system would have been virtually dismantled.
- B) Taiwan's employment market and scholarships would have shrunk because the traditional art forms would have had little representation.
- C) Painters whose work featured traditional scenes from village life would have found their sources of income dwindling.
- D) In spite of the Fifth Moon Group's success, many avant-garde artists still would have left Taiwan.

**62. The discussion of the emergence of the avant-garde movement in China in 1979 implies that the movement:**

- A) had been gathering momentum and gaining adherents for some time.
- B) was not a recognized part of the avant-garde but rather an offshoot.
- C) was nurtured by influential members of the art establishment.
- D) had been started by dissidents from the Communist Party.

**63. Based on the passage, which of the following artistic works would most likely have NOT been considered avant-garde in China between 1979 and the early 1990s?**

- A) A realistic painting of smiling factory workers
- B) A painting consisting of geometric shapes and pure color
- C) A depiction of the hardships of contemporary village life
- D) A painting of Chinese consumer products intended to parody modern values

**64. Based on the passage, the author most likely believes that Chinese art during the last half of the twentieth century was:**

- A) characterized by endless stylistic flux.
- B) transformed slowly by the challenges of the avant-garde movements.
- C) entrenched and in need of change.
- D) modernized without the cooperation of the academy system.

**65. Suppose that during the late 1990s, avant-garde art groups emerged in China that were both self-sustaining and primarily self-taught. Which of the following possible reasons for this, if true, is most compatible with the passage?**

- A) The avant-garde had finally been accepted by the academy system, which had undergone fundamental changes to accommodate these artists.
  - B) The Chinese socioeconomic system had tilted enough toward capitalism to provide income for talented artists regardless of their training and education.
  - C) The artists had modified the content and style of their art so that it conformed to the demands of the academy system.
  - D) New modes of income and markets had been found for Chinese artists that existed outside the academy system.
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**Passage V (Questions 66-70)**

Writing is speech made visible so any reader instructed in its conventions can reconstruct the vocal message. All modern linguists agree on this, but agreement is recent. Various claims preceded that agreement and some persist: misperceptions can be ferociously guarded.

Five thousand years ago, the Sumerians invented writing, followed swiftly by the Egyptians. Both scripts combined signs that were *phonemes* (signs based on sound) and *morphemes* (signs indicating syllables or categories). In the nineteenth century, Darwinian anthropologists believed that writing was key to societal evolution and proudly noted that their script reached back to the very civilized ancient Greeks. Yet, among Greek philosophers admired by those anthropologists, some questioned writing's worth.

Plato, the most admired, certainly did. In the *Phaedrus*, he argued that debating sharpened memories, corrected misconceptions, and produced truth. Writing “remembered” for people and could be misread, misconstrued, or misused. Text and reader could not argue, making erroneous readings undetectable. Only through speech were errors so correctable that truth could emerge. Thus, the spoken word was superior!

In the fifth century B.C.E., the great Greek scholar Herodotus visited Egypt to study its writing. He reported correctly that the script memorialized historical events, especially royal achievements. As Egyptian culture dwindled under the Classical world's onslaught, information transmitted by the Greeks about Egyptian writing became increasingly garbled. The script was allegedly ideographic, expressing metaphysical thoughts directly in script without letters, words, or sentences.

Athanasius Kircher (1602–1680), a leading scholar and scientist of the Renaissance, popularized this view. He translated one inscription, which actually spelled out the titles of pharaoh Psamtjik, as instructions on securing divine protection from the god Osiris instead. Kircher's reputation gave credibility to claims that Egyptian script was ideographic. Further, returning missionaries and explorers reported that Chinese and Mayan scripts were ideographic. This provided independent proof that nonalphabetic scripts used signs conveying metaphysical ideas—not phonemes, not morphemes.

Notions about ideographic scripts persisted. Eventually, both Egyptian and Chinese scripts were recognized as both phonetic and morphemic. By 1989, Mayan was shown to be phonetic and morphemic. Yet, some textbooks still refer to ancient Egyptian, Chinese, and Mayan writing as ideographic.

Perhaps some of this persistence can be explained by deeply rooted, societal presumptions common in colonizing societies about colonized societies. For example, in the nineteenth century, Darwinian anthropologists argued that societies followed a rigid, evolutionary hierarchy. Every society had to evolve from “savagery” through “barbarism” to “civilization.” Hunters and gatherers were stuck in “savagery.” Others still lived in “barbarism,” characterized by agriculture, animal husbandry, and clans based on kinship. Highly organized, individualistic, and industrialized, the Anglo-Saxon Americans and English were civilized. With time, savages and barbarians might rise to a similar enlightened status!

Paralleling societal hierarchy was a hierarchy of writing. Supposedly, every writing system evolved from simplistic pictures (pictographs) to direct expressions of ideas (ideographs) to letters representing sounds (alphabets). “Savages” drew a horse to mean “horse,” writing pictographically. “Barbarians” might draw a horse to mean “friendship,” writing ideographically. “Civilized” people wrote “horse” to represent sounds, writing phonetically. In brief, those who were civilized wrote phonetically—savages and barbarians didn't!

Adapted from M. D. Cole, *Breaking the Maya Code*. ©1992 by M. D. Cole

[Questions 66-70 for Passage V begin on following page.]

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**66. Given Plato’s claim that the spoken word is superior to the written word in the pursuit of truth, which of the following activities would he have been most likely to encourage today’s truth seekers to adopt?**

- A) Listening to candidates for political office debate each other on the radio
- B) Participating in a group that discusses *Phaedrus* and other written works at a local university
- C) Posing comments on Internet sites and using online chat rooms to discuss the issues of the day
- D) Getting involved in an ethics discussion group hosted by a public library

**67. The artificial language Esperanto was constructed from European languages and uses Western European alphabets. Based on the passage, this language would be most likely classified as:**

- A) ideographic.
- B) phonetic.
- C) morphemic.
- D) a combination of ideographic and phonetic.

**68. What evidence does the author use to support the contention that Renaissance scholars misunderstood Egyptian writing?**

- A) Egyptian writing was ideographic.
- B) Kircher incorrectly translated an inscription about Psamtjik.
- C) Missionaries and explorers discovered Chinese and Mayan scripts that were ideographic.
- D) Kircher was the first scholar to correctly understand Egyptian writing.

**69. Which of the following assertions, if true, would most support the author’s statement that “Egyptian culture dwindled under the Classical world’s onslaught” (paragraph 4)?**

- A) Greek scholars used discoveries by Egyptian astronomers to further their own studies.
- B) Egyptian scribes invented a flowing script for use in keeping economic records.
- C) Invaders from Alexander the Great to the Romans tried to integrate Egypt into their empires.
- D) Renaissance scholars incorrectly identified Greek script as ideographic.

**70. According to the passage, which of the following situations during the Renaissance supported the view that Egyptian script was ideographic?**

- I. Kircher’s claim that the Psamtjik inscription listed his titles
- II. Kircher’s reputation as a scholar and scientist
- III. Missionaries’ reports on Chinese and Mayan scripts

- A) I and II only
  - B) I and III only
  - C) II and III only
  - D) I, II, and III
-

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**Passage VI (Questions 71-75)**

Every animal species has an optimum size. Change it significantly, and the animal will have to undergo a change of form or become dysfunctional. Imagine a giant human being who is sixty feet high. This monster would be not only ten times as tall as a normal person, but also ten times as wide and ten times as thick. This means that its total weight would be a thousand times that of a normal human, or about eighty to ninety tons. Because the cross sections of its bones would be only a hundred times those of the normal human, every square inch of this giant's bone would have to support ten times the weight usually borne by a square inch of human bone. Unfortunately, the human thighbone breaks under about ten times the human weight, so these giants would break their thighs every time they took a step.

In a similar manner, if a gazelle (a graceful little creature with long thin legs) were to become significantly larger, it would break its bones unless it made its legs thick, like a rhinoceros, so that every pound of weight had still about the same area of bone to support it. Increased size would also destabilize it unless it stretched out its legs, obliquely, to gain stability, like a giraffe. With these changes, it would no longer be shaped like a gazelle.

Size also limits how an animal can absorb oxygen. Insects take air directly into every part of their body by means of tiny blind tubes called *tracheae*, which open to the surface at many different points. Although by breathing they can renew the air in the outer part of the tracheal system, the oxygen has to penetrate the system's finer branches by means of diffusion. Gases can diffuse easily through very small distances, not many times larger than the average length traveled by a gas molecule between collisions with other molecules. But when such "vast" journeys as a quarter of an inch have to be made, the process takes time. Since portions of an insect's body more than a quarter of an inch from the air would always be short of oxygen, very few insects are much more than half an inch thick.

Exactly the same difficulties attach to flying. It is an elementary principle of aeronautics that the minimum speed needed to keep an airplane of a given shape in the air varies with the square root of its length. If its linear dimensions are increased four times, it must fly twice as fast to remain airborne. Applying the same principles to the birds, we find that the limit to their size is soon reached. The strength of a bird's muscles, like that of its bones, is proportional to their cross sections. Imagine an airborne creature in human form whose muscles developed no more power (ounce for ounce) than those of an eagle or a pigeon. It would require a breast projecting outward about four feet to house all of the muscles needed to operate its wings; and its legs would have to be reduced to mere stilts to lower its total weight.

Just as there is an optimum size for every animal, so there is an optimum size for every human institution. In the pure democracy of ancient Greece, all citizens could listen to a series of orators and vote directly on questions of legislation. Greek philosophers held that a small city was the largest possible democratic state. The English invention of representative government made a large democratic nation possible, and modern communications technology made the political views of representative politicians accessible to all citizens of a large nation.

Adapted from J. B. S. Haldane, On being the right size. ©1928 by Harper and Row, Publishers, Inc.

**[Questions 71-75 for Passage VI begin on following page.]**

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**71. In discussing a giant human's weight, the passage author assumes that:**

- A) body weight and body strength vary in proportion to each other.
- B) a six-foot-tall human being weighs between 180 and 190 pounds.
- C) the weight of an organism is proportional to its volume.
- D) bone strength would increase to accommodate the additional weight.

**72. Which of the following, if true, would *challenge* the author's argument about the giant's ability to walk?**

- A) The strength of a material is proportional to its volume.
- B) Giant bone contains different material than ordinary human bone.
- C) Normal human bone breaks under a weight of about one-half ton.
- D) Giants would not move in exactly the same way as human beings of normal size.

**73. The author suggests two accommodations a gazelle might have to make if it became larger in order to avoid breaking its leg bones or losing its balance. Which of the following, if true, would NOT be analogous to one of those ways?**

- A) The trunks of large trees grow thicker relative to their height than the trunks of small trees in order to support the increase in weight.
- B) A tripod can support a heavy camera with more stability if its legs are more spread out.
- C) A cylinder of steel can support more weight than a cylinder of concrete identical in size.
- D) Truck tires that must bear heavier loads are wider than those that bear lighter loads.

**74. Which of the following, if true, would be most *inconsistent* with the author's explanation for why few, if any, insects are more than half an inch thick?**

- A) Diffusion of oxygen through distances as great as a quarter of an inch, which occurs in some insects' tracheae, is difficult.
- B) Superficial tracheal openings are located on the top as well as the bottom half of an insect's body.
- C) The outer openings of tracheae are much less than a quarter of an inch in diameter.
- D) The average distance that gas molecules travel between collisions with each other is about a quarter of an inch.

**75. Is the author's application of optimum size to human institutions consistent with the way the concept is applied to animals?**

- A) Yes, because it is supported by hypothetical examples
- B) Yes, because it asserts that the forms of political systems are functions of population size
- C) No, because it takes the metaphor of the "body politic" and treats it as if it were literally an organism
- D) No, because historical fact indicates that the analogy is misapplied

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### End of Verbal Reasoning Section

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**Verbal Reasoning Answer Key**

Question Number	Answer Key
43	D
44	A
45	B
46	A
47	C
48	C
49	C
50	D
51	D
52	A
53	C
54	D
55	A
56	D
57	B
58	D
59	B
60	C
61	C
62	A
63	A
64	C
65	D
66	D
67	B
68	B
69	C
70	C
71	C
72	A
73	C
74	D
75	B

**Verbal Reasoning Raw Score to Scale Score Conversion Table**

Raw Score	Scale Score
0	1
1	1
2	1
3	1
4	1
5	1
6	1
7	1
8	2
9	2
10	3
11	3
12	4
13	4
14	5
15	5
16	6
17	6
18	7
19	7
20	8
21	8
22	9
23	9
24	10
25	10
26	10
27	11
28	11
29	12
30	12
31	13
32	14
33	15

## **BIOLOGICAL SCIENCES SECTION**

## Biological Sciences

Questions 76 – 117

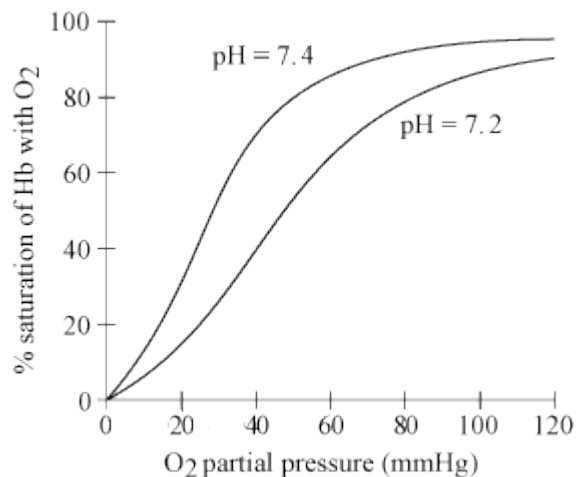
**DIRECTIONS:** Most questions in the Biological Sciences test are organized into groups, each preceded by a descriptive passage. After studying the passage, select the one best answer to each question in the group. Some questions are not based on a descriptive passage and are also independent of each other. You must also select the one best answer to these questions. If you are not certain of an answer, eliminate the alternatives that you know to be incorrect and then select an answer from the remaining alternatives. Indicate your selection by clicking on the answer bubble next to it. A periodic table is provided for your use. You may consult it whenever you wish.



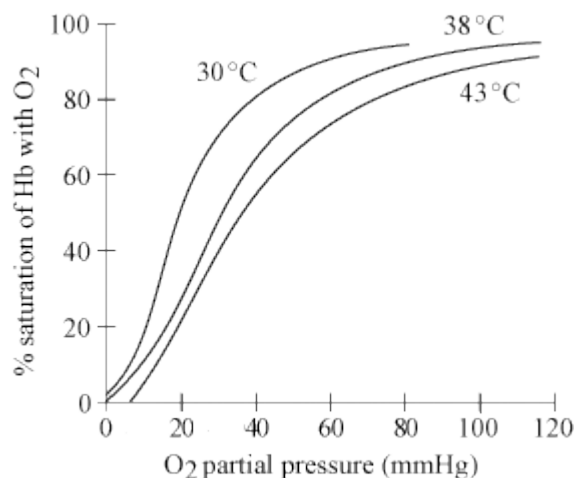
**Passage I (Questions 76-81)**

Oxygen is transported in the blood primarily by the globular protein hemoglobin (Hb). The Hb-O<sub>2</sub> dissociation curve shows the amount of O<sub>2</sub> that is bound to Hb under a given set of conditions. The extent of O<sub>2</sub> binding depends on such factors as the partial pressure of O<sub>2</sub>, the pH of the blood (Figure 1), the temperature of the blood (Figure 2), and the structure of the hemoglobin molecule itself (Figure 3).

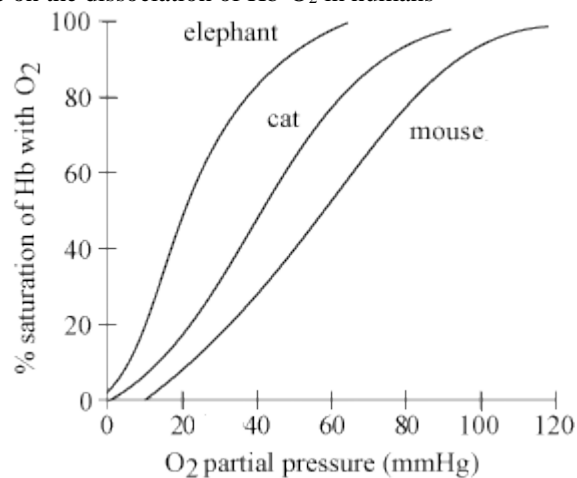
In normal humans, at rest, the average partial pressure of O<sub>2</sub> in the lungs is about 100 mmHg, and the partial pressure of O<sub>2</sub> in tissues is about 40 mmHg. Normal resting blood pH is 7.4.



**Figure 1** Effect of blood pH on the dissociation of Hb-O<sub>2</sub> in humans



**Figure 2** Effect of temperature on the dissociation of Hb-O<sub>2</sub> in humans



**Figure 3** Hb-O<sub>2</sub> dissociation curves for 3 species

Adapted from W. T. Keeton and J. L. Gould, *Biological Science*. ©1986 by W. W. Norton and Company, Inc.

[Questions 76-81 for Passage I begin on following page.]

**76. When a person engages in strenuous muscular activity, more O<sub>2</sub> is delivered to the muscle tissues than at rest. Which of the following changes in the blood within muscle tissue aids in this increase in O<sub>2</sub> delivery?**

- A) Both temperature and pH decrease.
- B) Both temperature and pH increase.
- C) Temperature decreases and pH increases.
- D) Temperature increases and pH decreases.

**77. What is the approximate saturation of Hb with O<sub>2</sub> in the capillary beds within the tissues of a human at rest?**

- A) 15%
- B) 30%
- C) 70%
- D) 95%

**78. Based on the figures, an increase in which of the following factors leads to an increase in the capacity of the blood to carry O<sub>2</sub>?**

- A) pH only
- B) Temperature only
- C) Both pH and partial pressure of O<sub>2</sub>
- D) Both temperature and partial pressure of O<sub>2</sub>

**79. In the muscle tissue, some O<sub>2</sub> is transferred from Hb to myoglobin, and the O<sub>2</sub> is stored in the muscle as an O<sub>2</sub>–myoglobin complex. In comparison to the O<sub>2</sub> dissociation curve for Hb, the dissociation curve for myoglobin is shifted to the:**

- A) left, because myoglobin binds O<sub>2</sub> more tightly than does Hb.
- B) left, because myoglobin binds O<sub>2</sub> more loosely than does Hb.
- C) right, because myoglobin binds O<sub>2</sub> more tightly than does Hb.
- D) right, because myoglobin binds O<sub>2</sub> more loosely than does Hb.

**80. The dissociation curves in the passage are S-shaped because:**

- A) the first molecule of O<sub>2</sub> binds to Hb less readily than does the second molecule of O<sub>2</sub>.
- B) the first molecule of O<sub>2</sub> binds to Hb more readily than does the second molecule of O<sub>2</sub>.
- C) the heme group of Hb changes conformation at low partial pressures of O<sub>2</sub>.
- D) Hb is composed of both  $\alpha$  and  $\beta$  polypeptide chains.

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**81. Based on Figure 3, the percentage saturation of Hb with O<sub>2</sub> increases with all of the following EXCEPT:**

- A) body mass.
  - B) body volume.
  - C) partial pressure of O<sub>2</sub>.
  - D) the ratio of surface area to volume.
-

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**Passage II (Questions 82-85)**

Assume that coat color in hamsters is determined by a single gene that has only two alleles. Individuals homozygous for  $C^B$  are dark brown, individuals homozygous for  $C^b$  are pure white, and heterozygotes are light brown. Hamsters of all colors are equally viable and fertile.

A pet store owner has four dark brown hamsters (two males and two females). The owner receives a shipment of 16 white hamsters (8 males and 8 females), all of which the owner houses together with the dark brown hamsters in a large cage. The hamsters mate randomly, and the females produce a total of 100 offspring.

A teacher needs 25 pairs of young hamsters for a school project. The teacher would like a dark brown and a pure white hamster in each pair. Without looking at the animals, the owner assures the teacher that the store can supply all of the hamsters, as specified, from the  $F_1$  offspring. (The original parents are too old for the project.)

**[Questions 82-85 for Passage II begin on following page.]**

**82. According to the passage, the two alleles for coat color show which of the following patterns of inheritance?**

- A) Complete dominance
- B) Incomplete dominance
- C) Recessiveness
- D) Heterozygosity

**83. According to the passage, is it likely that natural selection on the basis of coat color is occurring in the hamsters?**

- A) Yes, because the caged hamsters mate randomly
- B) Yes, because there are more white than dark brown hamsters in the population
- C) No, because hamsters of all coat colors are equally viable and fertile
- D) No, because there are three coat colors that are determined by only one gene

**84. For the school project, each student will examine the offspring from a dark brown and a white hamster. What will be the color(s) of these offspring?**

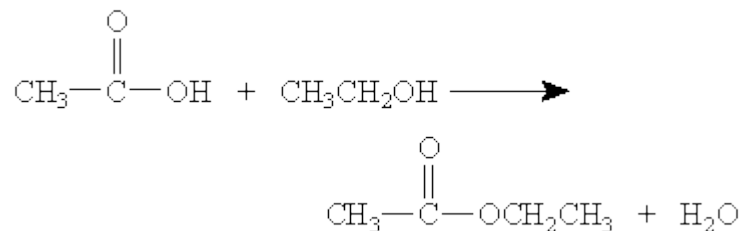
- A) All of the offspring will be light brown.
- B) All of the offspring will be dark brown.
- C) Approximately three-quarters of the offspring will be dark brown and one-quarter of the offspring will be white.
- D) Approximately one-half of the offspring will be light brown, one-quarter of the offspring will be white, and one-quarter of the offspring will be dark brown.

**85. Based on the passage, it is most likely that the quantity of enzyme produced by the gene for coat color in hamsters is:**

- A) equal in hamsters of all coat colors.
  - B) zero in white, intermediate in light brown, and high in dark brown.
  - C) zero in white and equal in light brown and in dark brown.
  - D) intermediate in white and in light brown and high in dark brown.
-

Questions 86-90 are NOT related to a passage.

86. Acetic acid and ethanol react to form an ester product as shown below.



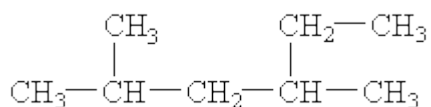
In determining which reactant loses the  $-\text{OH}$  group, which of the following isotopic substitutions would be most useful?

- A) Replace the acidic H of acetic acid with D.
- B) Replace the alcoholic H of ethanol with D.
- C) Replace the carbonyl oxygen of acetic acid with O-18.
- D) Replace the hydroxyl oxygen of ethanol with O-18.

87. Epilepsy may result in motor seizures due to massive synchronous firing of neurons in a small area of the cerebral cortex (the *epileptic focus*). Excitation spreads from the focus, involving an increasingly larger area of the cortex. A drug for the treatment of epilepsy would be most effective if it caused which of the following changes in the epileptic focus?

- A) An increase in the neuron-firing threshold
- B) An increase in extracellular  $\text{Na}^+$  concentration
- C) A decrease in axon-membrane permeability to negative ions
- D) A decrease in the length of the depolarization stage

88.



How many stereogenic carbon atoms appear in the structure above?

- A) 0
- B) 1
- C) 2
- D) 4

---

**89. Enzymes alter the rate of chemical reactions by all of the following methods EXCEPT:**

- A) co-localizing substrates.
- B) altering local pH.
- C) altering substrate shape.
- D) altering substrate primary structure.

**90. In general, telomeres are NOT important to bacterial cells because most bacterial chromosomes:**

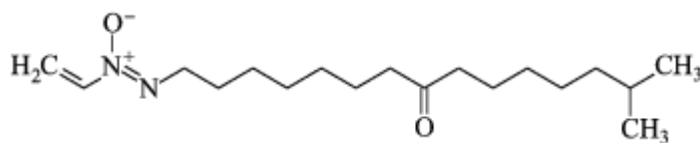
- A) do not replicate.
  - B) are circular.
  - C) replicate quickly and efficiently.
  - D) are composed of single-stranded DNA.
-



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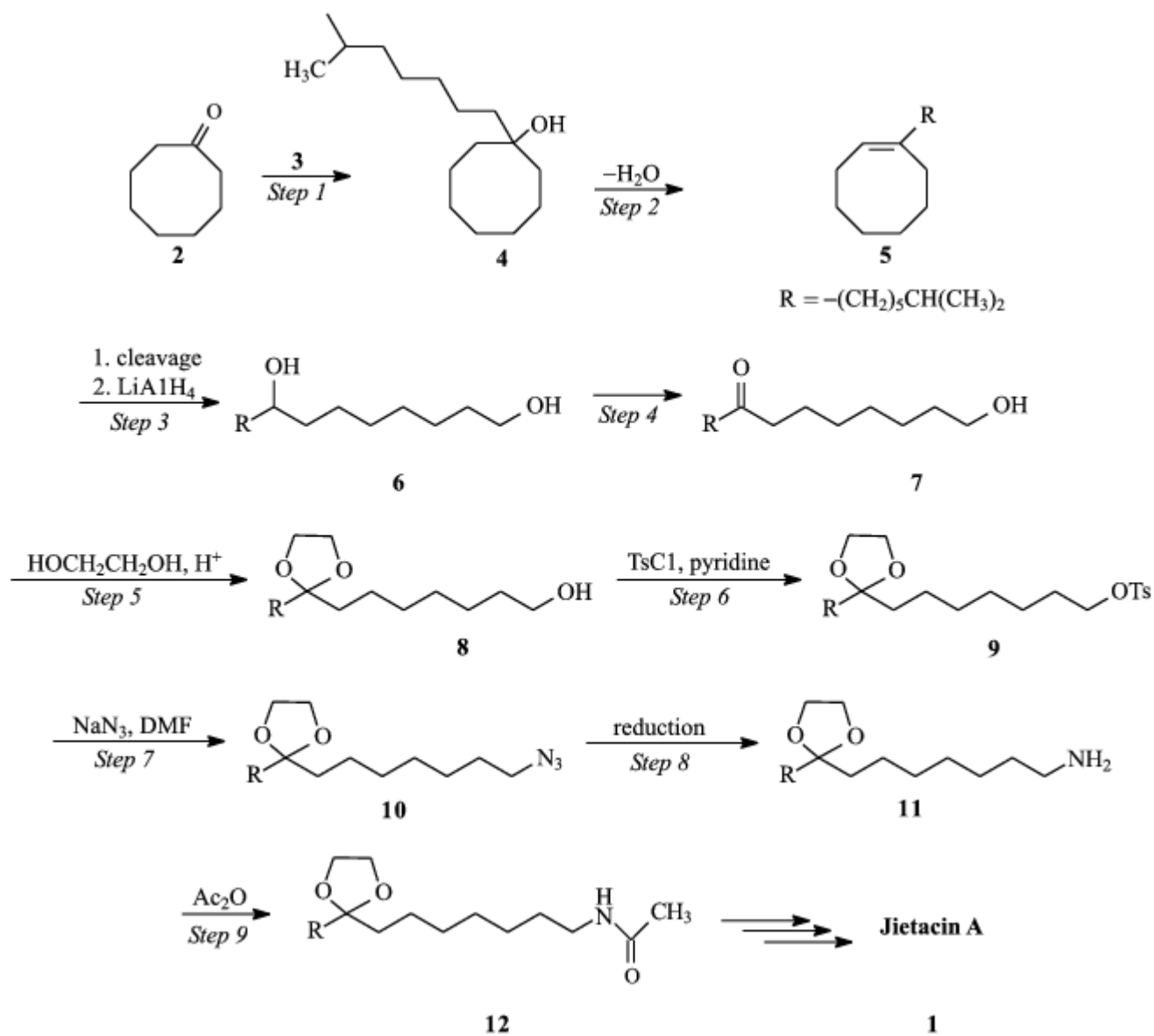
**Passage III (Questions 91-97)**

Jietacin A (**1**) is an antibiotic that also shows potent activity against the pine wood nematode. Its remarkable nematocidal activity along with its unusual azoxy ( $\text{N}=\text{N}^+-\text{O}^-$ ) group makes it of interest to agricultural chemists.



**Jietacin A**

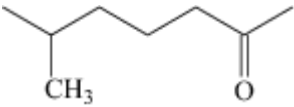
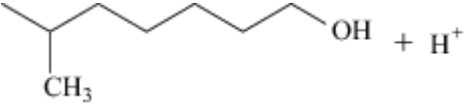
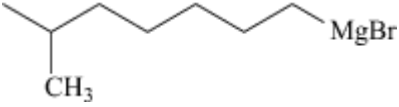
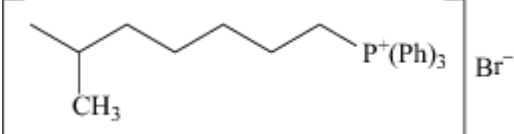
A synthesis of Jietacin A is shown below as Scheme 1. The synthesis starts with cyclooctanone **2**, which was converted to the alcohol **4** by addition of reagent **3**. Compound **4** was then dehydrated to give cyclooctene **5**. Oxidative cleavage of **5** was followed by reductive workup with lithium aluminum hydride to give the diol **6**. Compound **6** was selectively oxidized and then protected using ethylene glycol under standard conditions to give Compound **8**. Compound **8** was then treated with toluene sulfonyl chloride (TsCl). The resultant tosylate **9** was treated with  $\text{NaN}_3$  in the polar aprotic solvent dimethylformamide (DMF). Azide **10** was reduced and acetylated with acetic anhydride to yield amide **12**. Jietacin A was synthesized in five further steps.



Scheme 1

[Questions 91-97 for Passage III begin on following page.]

91. What is the structure of Reagent 3?

- A) 
- B)  + H<sup>+</sup>
- C)  MgBr
- D) 

92. Confirmation that the conversion of Compound 6 to 7 in Step 4 was successful could be obtained best from changes in:

- A) the ultraviolet spectrum, because the carbonyl and hydroxyl group in Compound 7 will absorb strongly.
- B) the infrared spectrum, because the carbonyl and hydroxyl group in Compound 7 will absorb strongly.
- C) the optical activity, because Step 4 gives only one enantiomer.
- D) the TLC, because Compound 7 will have a lower  $R_f$  than does 6.

93. What is the IUPAC name of Compound 7?

- A) 2-Methyl-14-hydroxy-8-pentadecanone
- B) 1-Hydroxy-13-isopropyl-8-tetradecanone
- C) 1-Hydroxy-14-methyl-8-pentadecanone
- D) 8-Keto-14-methylpentadecanol

94. The reaction of Compound 9 to give Compound 10 in Step 7 would:

- A) be accelerated by an increase in NaN<sub>3</sub> concentration.
- B) be accelerated by the substitution of hexanes as a reaction solvent.
- C) be slowed by an increase in reaction temperature.
- D) give a racemic product.

---

**95. On first-order analysis of the proton NMR spectrum of Compound 5, the olefinic hydrogen would appear as:**

- A) a singlet.
- B) a doublet.
- C) a triplet.
- D) a quartet.

**96. The configuration around the N=N double bond of Jietacin A can be assigned in the same manner used to assign configuration about carbon-carbon double bonds. Using the IUPAC convention, what is the correct configuration?**

- A) *R*
- B) *S*
- C) *E*
- D) *Z*

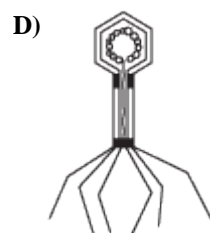
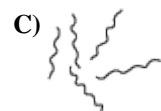
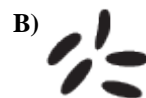
**97. Which reagent could most successfully be substituted for acetic anhydride in Step 9?**

- A) Acetamide
  - B) Acetaldehyde
  - C) Acetyl chloride
  - D) Acetic acid
-

---

Questions 98-99 are NOT related to a passage.

98. Based on its shape, an organism was classified as a *bacillus*. Which of the following diagrams correctly represents the shape of the organism?



99. Smooth muscles are responsible for contractions in all of the following structures EXCEPT the:

- A) iris.
  - B) uterus.
  - C) diaphragm.
  - D) alimentary canal.
-

---

**Passage IV (Questions 100-105)**

Cystic fibrosis (CF) is a common genetic disease in humans. CF is caused by mutations of the cystic fibrosis transmembrane conductance regulator (CFTR) gene. The CFTR gene is found on an autosome. The most common mutation of the CFTR protein ( $\Delta F508$ ) results in a deleted phenylalanine at amino acid residue 508. Individuals homozygous for this allele exhibit CF. In some populations, the frequency of the  $\Delta F508$  allele is as high as 0.05, leading researchers to investigate why this harmful allele is so common.

One hypothesis is heterozygote superiority. Under this hypothesis, individuals heterozygous for  $\Delta F508$  would have increased resistance to typhoid fever.

The causative agent of typhoid fever is the bacterium *Salmonella typhi*. *S. typhi* enters the body via contaminated food or water and then crosses the epithelial cells of the small intestine. CFTR has been shown to be a major epithelial cell receptor for internalization of *S. typhi* in the gastrointestinal system. Human epithelial cells expressing  $\Delta F508$  CFTR ingest significantly fewer *S. typhi* than do epithelial cells that express wild-type CFTR. In addition, an antibody specific for the first extracellular domain of human CFTR inhibits the uptake of *S. typhi*. Therefore, it seems plausible that diminished levels of CFTR in  $\Delta F508$  heterozygotes may decrease the heterozygotes' susceptibility to *S. typhi* infection. If so, the selective advantage of the  $\Delta F508$  allele would help explain the high incidence of CF in some populations.

Passage based on G. B. Pier et al., "*Salmonella typhi* uses CFTR to enter intestinal epithelial cells." ©1998 by Macmillan Publishers Ltd.

**[Questions 100-105 for Passage IV begin on following page.]**

---

**100. Assume that the heterozygote superiority hypothesis is correct. If typhoid fever were eradicated, the incidence of CF would most likely:**

- A) decrease.
- B) increase.
- C) remain unchanged.
- D) fluctuate randomly.

**101. What is the probability that a child born to parents, each of whom is heterozygous with one  $\Delta F508$  and one wild-type CFTR allele, will have CF?**

- A) 0.00
- B) 0.25
- C) 0.50
- D) 0.75

**102. Assume that *S. typhi* immediately enters the bloodstream from the small intestine. Of the following, which would be the first major organ that bloodborne *S. typhi* would encounter?**

- A) Stomach
- B) Pancreas
- C) Large intestine
- D) Liver

**103. Researchers have noted that chloramphenicol (a commonly used antibiotic) is becoming less effective in treating typhoid fever. The best explanation for this observation would be selection:**

- A) against chloramphenicol in  $\Delta F508$  heterozygotes.
- B) against chloramphenicol in wild-type homozygotes.
- C) for chloramphenicol resistance in populations of *S. typhi*.
- D) for  $\Delta F508$  CFTR, which cannot bind chloramphenicol.

**104. G542X is another CFTR allele. If a female heterozygous for G542X bears a child fathered by a male heterozygous for the  $\Delta F508$  allele, what is the probability that the child would be homozygous for the G542X allele, given that neither parent has CF?**

- A) 0.00
- B) 0.25
- C) 0.75
- D) 1.00

---

**105. Which of the following best describes the phenotype of an individual who is heterozygous with one  $\Delta F508$  and one wild-type CFTR allele?**

- A) More susceptible to typhoid fever than wild-type homozygotes and has CF
  - B) More susceptible to typhoid fever than  $\Delta F508$  homozygotes and does not have CF
  - C) More resistant to typhoid fever than  $\Delta F508$  homozygotes and has CF
  - D) More resistant to typhoid fever than wild-type homozygotes and does not have CF
-



---

**Passage V (Questions 106-109)**

The classical description of a neuron proposes a cell with multiple branching protrusions called dendrites and a single long slender protrusion called an axon. Nerve impulses are pictured as flowing toward the cell body along the dendrites and away from the cell body along the axon. This classical conception is only part of the story.

The nerve impulse is a change in voltage across the cell membrane. It may be passively propagated as it is on the classical cell body and dendrites or actively propagated as it is on the axon. Neurotransmitter receptors on the cell body and dendrites can open channels, thus altering the voltage locally. Membrane channels on axons are electrically gated. By sensing distant changes in voltage, the nerve impulse can be actively propagated toward the axon terminal.

It has long been known that some nerve cells do not have axons. The amacrine cell in the retina of the eye is an example of such a cell. More recently it has been appreciated that an enormous number of other cells in the central nervous system lack axons. The reception and release of neurotransmitters by these cells take place only locally. In other cells it is difficult to reconcile the classical description of a neuron with its functional parts. Nerve impulses may be actively propagated toward the cell body, as in the dorsal root ganglion cells and pyramidal cells of the cerebral cortex, making it hard to decide whether these processes should be considered axons or dendrites. Considerations such as these have suggested a new definition of an axon as a portion of a nerve cell that contains electrically gated ion channels and the recognition that such a region is not necessary for nerve cell function.

**[Questions 106-109 for Passage V begin on following page.]**

**106. The passage suggests that some nerve cells lack:**

- A) a cell membrane.
- B) neurotransmitters.
- C) voltage-gated ion channels.
- D) chemically gated ion channels.

**107. Creation of an electrochemical gradient across the cell membrane of nerve cells is an energy-intensive process. The most abundant source of energy for maintaining a constant resting membrane potential in an axon must be:**

- A) glycolysis in the cytoplasm of the axon.
- B) the flow of potassium ions down a diffusion gradient out of the cell.
- C) the flow of sodium ions down an electrochemical gradient into the cell.
- D) oxidative phosphorylation carried out in very slender mitochondria inside the axon cylinder.

**108. The velocity of an action potential increases with the diameter of the axon and is faster in myelinated axons than in unmyelinated axons. What class of nerve fibers seems most poorly matched to its function judging from the information in Table 1?**

**Table 1** Function of Various Types of Axons Compared to Their Characteristics

Axons	Description	Function
A	11–20 $\mu\text{m}$ , myelinated	motor fibers to skeletal muscle, sense of body position
A $\delta$	2–5 $\mu\text{m}$ , myelinated	pain, temperature
B	5–10 $\mu\text{m}$ , myelinated	preganglionic autonomic, touch, pressure
C	0.5– 4 $\mu\text{m}$ , unmyelinated	pain

- A) A axons
- B) A $\delta$  axons
- C) B axons
- D) C axons

---

**109. The chromaffin cells of the adrenal medulla are essentially nerve cells. Preganglionic, acetylcholine-secreting nerve endings synapse on them and in response to stimulation they release epinephrine and norepinephrine into the bloodstream. Given their function, it is likely that these cells lack:**

- A) axons and dendrites.
  - B) axons and chemically gated ion channels.
  - C) electrically gated and chemically gated channels.
  - D) chemically gated channels and dendrites.
-

**Passage VI (Questions 110-114)**

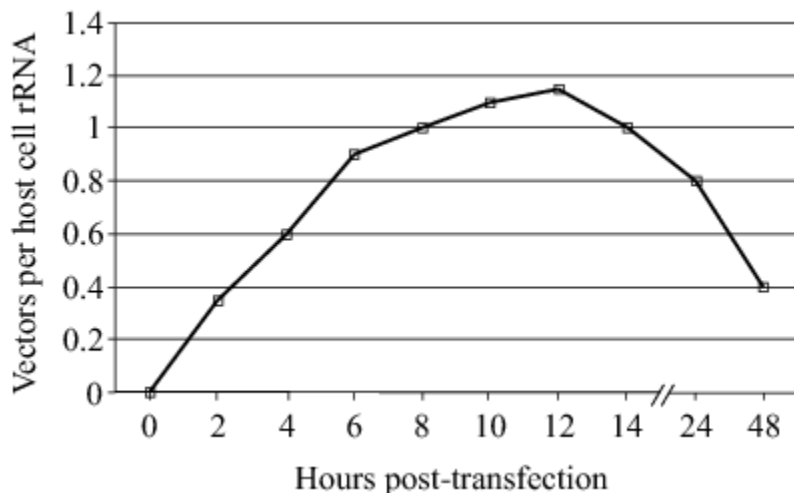
Most vaccines against viruses consist of either killed viruses or attenuated live viruses (viruses selected because they lack pathogenic characteristics). More recently vaccines have been developed using recombinant DNA to make the proteins found in the target pathogenic organism.

Live virus vaccines confer long-lasting immunity, but there is the possibility that the viruses could mutate to become destructive once again. Furthermore, they can pose a danger to people with weakened immune systems. A more recent approach, the use of genetically engineered, self-replicating nucleic acid vaccines, combines both the long-lasting exposure offered by live viruses and the safety of recombinant proteins. Self-replicating nucleic acid vaccines might also be effective against cancer cells.

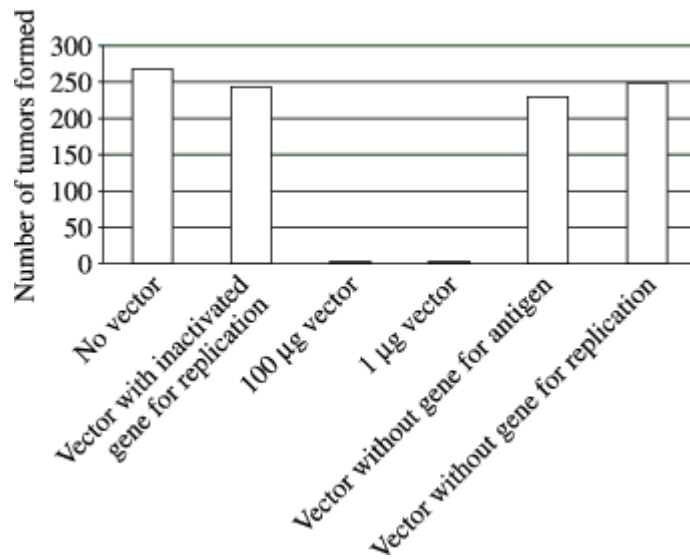
An experimental self-replicating RNA vector was constructed for use as a vaccine against cancer cells. This vector had only two genes. The first was a gene encoding a polypeptide complex of enzyme that allowed the RNA to be self-replicating. The second was a gene for the enzyme  $\beta$ -galactosidase. The  $\beta$ -galactosidase gene was used because its presence in cells allowed the cells to be easily visualized, and to provoke an immune response.

The self-replicating RNA vector was injected into mice and the number of vector molecules was measured over time (Figure 1). Then, scientists created several versions of the RNA molecule with various combinations of genes and investigated the effectiveness of these as vaccines against the development of tumors. They immunized mice using the self-replicating RNA molecules and then challenged them with tumor cells that had been genetically engineered to express  $\beta$ -galactosidase. Under some conditions numerous tumors were observed in the lungs; while under others, few were observed (Figure 2).

The scientists found that the RNA vaccine entered cells by transfection. They found evidence that cells containing the foreign RNA had died and speculated that antigen released from dying cells might have then been recognized by the immune system.



**Figure 1** Changes in number of vector molecules in a tissue sample over time compared to number of 18S rRNA molecules



**Figure 2** Number of tumors under six conditions of immunization

[Questions 110-114 for Passage VI begin on following page.]

**110. The primary advantage offered by the self-replicating RNA vaccine described in the passage over those based on recombinant proteins is that the antigen:**

- A) has a longer effect because RNA is more stable in the body than protein.
- B) has a longer effect because the RNA is self-replicating.
- C) elicits a more specific antibody response because the genes are specified exactly through genetic engineering.
- D) is more effective at eliciting antibody production because RNA is more antigenic than protein.

**111. Vector RNA serves as a template to directly manufacture  $\beta$ -galactosidase using:**

- A) its own polyprotein replicase.
- B) its own translation proteins.
- C) the host cell's ribosomes.
- D) the host cell's nuclear transcription machinery.

**112. According to the data in Figure 2, what is the most likely target of the immune response?**

- A) The  $\beta$ -galactosidase protein
- B) The replicase polyprotein
- C) The vector RNA coding for  $\beta$ -galactosidase
- D) The vector RNA coding for the replicase polyprotein

**113. Researchers inserted the  $\beta$ -galactosidase gene into the vector because it:**

- A) enabled the RNA vector to be self-replicating.
- B) enabled the vector to use galactose as an energy source.
- C) served as a target for RNA-degrading enzymes.
- D) served as a model antigen.

**114. What kind of RNA would NOT be directly involved in production of  $\beta$ -galactosidase in the system described in the passage?**

- A) Vector RNA
  - B) Host rRNA
  - C) Host tRNA
  - D) Host mRNA
-

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Questions 115-117 are NOT related to a passage.

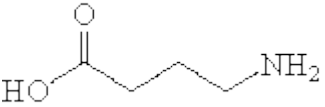

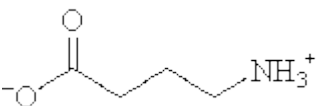

115. When concentrated urine is being produced, in which of the following regions of the kidney will the glomerular filtrate reach its highest concentration?

- A) Proximal convoluted tubule
- B) Distal convoluted tubule
- C) Cortical portion of the collecting duct
- D) Medullary portion of the collecting duct

116. All of the following information could be used to readily distinguish between the pulmonary vein and the aorta EXCEPT the:

- A) thickness of the walls of the vessels.
- B) elasticity of the walls of the vessels.
- C) oxygenation of the blood in the vessels.
- D) presence of semilunar valves at the bases of the vessels.

117. The neurotransmitter GABA ( $\gamma$ -aminobutyric acid) has measured  $pK_a$ 's of 4.03 and 10.6. What is the predominant form of GABA at pH 7?

- A) 
- B) 
- C) 
- D) 

---

**End of Biological Sciences Section**

**Biological Sciences Answer Key**

Question Number	Answer Key
76	D
77	C
78	C
79	A
80	A
81	D
82	B
83	C
84	A
85	B
86	D
87	A
88	B
89	D
90	B
91	C
92	B
93	C
94	A
95	C
96	D
97	C
98	B
99	C
100	A
101	B
102	D
103	C
104	A
105	D
106	C
107	D
108	D
109	A
110	B
111	C
112	A
113	D
114	D
115	D
116	C
117	C



**Biological Sciences Raw Score to Scale Score Conversion Table**

Raw Score	Scale Score
0	1
1	1
2	1
3	1
4	1
5	1
6	1
7	1
8	1
9	1
10	1
11	2
12	3
13	3
14	4
15	4
16	5
17	5
18	6
19	6
20	6
21	7
22	8
23	8
24	8
25	8
26	9
27	9
28	9
29	10
30	10
31	10
32	10
33	11
34	11
35	11
36	12
37	12
38	13
39	14
40	14
41	15
42	15

**END OF MCAT EXAM**

## **EXHIBIT D**

2008/2009

This booklet is provided  
free of charge.

The **ACT**<sup>®</sup>

# Preparing for the ACT



## What's Inside:

- Full-Length Practice Tests, including Writing
- Information about the Optional Writing Test
- Strategies to Prepare for the Tests
- What to Expect on Test Day

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**ACT**<sup>®</sup>

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## A Message to Students

This booklet, which is provided **free of charge**, is intended to help you do your best on the ACT. It summarizes general test-taking strategies, describes the content of each test, provides specific tips for each, and lets you know what to expect on test day. Included in this booklet are **complete practice tests**—“retired” ACT questions that were administered to students on a national test date, including a writing prompt—a sample answer document, and self-scoring instructions.

Read this booklet carefully and take the practice tests well before test day so you will be familiar with the tests, what they measure, and the strategies you can use to do your best on test day.

ACT is committed to representing the diversity of our society in all its aspects, including race, ethnicity, and gender. Thus, test passages, questions, and writing prompts are deliberately chosen to reflect the range of cultures in our population.

We also are committed to ensuring that test questions and writing prompts are fair—that they do not disadvantage any particular group of examinees. Extensive reviews of the fairness of test materials are rigorously conducted by both ACT staff and external consultants. We also employ statistical procedures to help ensure that our test materials do not unfairly affect the performance of any group.

ACT endorses the *Code of Fair Testing Practices in Education* and the *Code of Professional Responsibilities in Educational Measurement*, guides to the conduct of those involved in educational testing. ACT is committed to ensuring that each of its testing programs upholds the guidelines in each *Code*. A copy of each *Code* may be obtained free of charge from ACT Customer Services (68), P.O. Box 1008, Iowa City, IA 52243-1008, 319/337-1429.

## Additional ACT Preparation Materials

- **ACT Online Prep™**: The only online test preparation program designed exclusively by ACT test development professionals. ACT Online Prep has practice test questions, a practice essay with real-time scoring, a diagnostic test, and a personalized Study Path. You can access ACT Online Prep via the Internet anywhere and at any time. Order at **[www.actonlineprep.com](http://www.actonlineprep.com)**.
- The ***Real ACT Prep Guide*** is the official print guide to the ACT. This book includes three practice tests previously used in actual administrations—each with an optional Writing Test, with explanations for all right and wrong answer choices. Order at **[www.actstudent.org](http://www.actstudent.org)**.

## 1 General Preparation for the ACT® Tests

### Choosing a Test Option

Students may register for one of two Test Options: the ACT (No Writing) or the ACT Plus Writing, which includes a 30-minute Writing Test, and has a higher fee. The ACT Writing Test complements the ACT English Test. The combined results from both tests provide information about your understanding of the conventions of standard written English and your ability to produce a direct sample of your writing. Taking the ACT Plus Writing will provide you with two additional scores: a Writing subscore and a Combined English/Writing score. Taking the ACT Writing Test does **not** affect your subject area scores or your Composite score.

Not all colleges require or recommend taking the ACT Writing Test. Check directly with the colleges you are considering to find out their requirements, or ask your high school counselor which Test Option you should take. You can also check **[www.actstudent.org](http://www.actstudent.org)** for a list of colleges that have provided information to us about their policies—whether they require, recommend, or do not need results from the ACT Writing Test. Consult this list before you register, so you will know which Test Option to select.

The ACT Plus Writing is available within the United States, U.S. territories, and Canada on all established test dates and for Special and Arranged Testing during designated testing windows. The ACT Plus Writing is available internationally only in October, December, and April.

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## Choosing a Test Date

Before you choose a test date, check the application deadlines of the colleges and scholarship agencies you are considering. It will normally take three to eight weeks after a test date for ACT to mail your score report to you and to your college or scholarship choices.

Many colleges and scholarship agencies recommend that students take the ACT during the spring of their junior year. By this time, students typically have completed most of the coursework covered by the ACT. There are a number of advantages in taking the ACT then:

- You will receive test scores and other information that will help you plan your senior year of high school.
- Many colleges begin contacting prospective students during the summer before their senior year.
- If you do not score as well as you believe you can, there will be opportunities to retake the ACT in the fall of your senior year and still have your new scores available in time to meet admission and scholarship deadlines.

**NOTE: You cannot plan on receiving your scores from one test date in time to register for the next.**

## General Test-Taking Strategies for the ACT

The ACT contains multiple-choice tests in four areas: English, Mathematics, Reading, and Science. Each of these tests contains questions that offer either four or five answer choices from which you are to choose the correct, or best, answer. The following suggestions apply to all four tests:

### ***Pace yourself.***

The time limits set for each test give nearly everyone enough time to finish all the questions. However, because the English, Reading, and Science Tests contain a considerable amount of text, it is important to pace yourself so you will not spend too much time on one passage. Similarly, try not to spend too much time puzzling over an answer to a specific problem in the Mathematics Test. Go on to the other questions and come back if there is time. Your supervisor will announce when you have five minutes remaining on each test.

### ***Read the directions for each test carefully.***

Before you begin taking one of the tests, read the directions carefully. The English, Reading, and Science Tests ask for the “best” answer. Do not respond as soon as you identify a correct answer. Read and consider all of the answer choices and choose the answer that *best* responds to the question.

The Mathematics Test asks for the “correct” answer. Read each question carefully to make sure you understand the type of answer required. Then, you may want to work out the answer you feel is correct and look for it among the choices given. If your answer is not among the choices provided, reread the question and consider all of the answer choices.

### ***Read each question carefully.***

It is important that you understand what each question asks. Some questions will require you to go through several steps to find the correct or best answer, while others can be answered more quickly.

### ***Answer the easy questions first.***

The best strategy for taking the tests is to answer the easy questions and skip the questions you find difficult. After answering all of the easy questions, go back and answer the more difficult questions.

### ***Use logic on more difficult questions.***

When you return to the more difficult questions, try to use logic to eliminate incorrect answers to a question. Compare the answer choices to each other and note how they differ. Such differences may provide clues as to what the question requires. Eliminate as many incorrect answers as you can, then make an educated guess from the remaining answers.

### ***Answer every question.***

Your score on the tests will be based only on the number of questions that you answer correctly; **there is no penalty for guessing**. Thus, you should answer every question within the time allowed for each test, even if you have to guess. Your supervisor will announce when you have five minutes remaining on each test.

### ***Review your work.***

If there is time left after you have answered every question in a test, go back and check your work on that test. Check to be sure that you marked only one response to each question. You will not be allowed to go back to any other test or mark responses to a test after time has been called on that test.

### ***Be precise in marking your answer document.***

Be sure that you fill in the correct ovals on your answer document. Check to be sure that the number of the line of ovals on your answer document is the same as the number of the question you are answering and that you mark only one response for each question.

### ***Erase completely.***

If you want to change a multiple-choice answer, be sure to use a soft eraser that will not leave smudges and erase the unintended mark completely. Do not cross out answers or use correction fluid or tape; you must erase. Correction fluid/tape, smudges, or unintended marks may cause errors in scoring.

### **To students approved to test at national test centers with extended time:**

You will be allowed up to 5 hours total to work on the multiple-choice tests at your own pace, including breaks between tests. If you are taking the ACT Plus Writing, you will be allowed up to 5 hours and 45 minutes total. You will need to pace yourself through each test in order to complete all tests within the total time allowed. Your supervisor will provide time updates every hour. When you complete each test, you must notify your supervisor that you are ready to begin the next test.

## General Test-Taking Strategies for the ACT Writing Test

The ACT Writing Test lets you show your skill in planning and composing a short essay. It measures writing proficiencies that are taught in high school and are important for readiness to succeed in entry-level college composition courses.

The following general strategies will help if you take the ACT Writing Test.

### ***Pace yourself.***

You will have 30 minutes to write your essay. It is important to pace yourself in the way that best suits your personal writing strategy. Many writers do best when they spend part of their time planning their essay, most of their time writing the essay, and the last part of their time reviewing the essay to make corrections and small revisions. There is no formula for the best proportion of time to spend planning, writing, and reviewing: writers, topics, and occasions differ too widely for a universal rule to apply. Keep in mind, however, that you are unlikely to have time to draft, revise, and recopy your essay. Therefore, taking a few minutes to plan your essay is a much better strategy than writing a first draft with the intent to copy it over for the final essay.

In general, budget your time in the way that feels best to you based on your experience in taking essay tests in school and in other circumstances when you've done writing within a time limit. Your supervisor will announce when you have five minutes remaining on the Writing Test.

### ***Read the directions carefully.***

Before you begin the Writing Test, read the directions carefully. They tell you the aspects of writing on which your essay will be evaluated and give instructions on how to write your essay in the answer folder.

### ***Read the writing prompt carefully.***

It is important that you understand exactly what the writing prompt asks you to do. A firm grasp of the assignment is as crucial for the ACT Writing Test as it is for writing essays for class. Be sure you have a clear understanding of the issue in the writing prompt and of the question you must respond to before you start to plan and write your essay.

### ***Write (or print) legibly in the answer folder.***

If your readers cannot make out what you have written, they cannot appreciate what you have said, and they will not be able to score your essay. You may write or print your essay, whichever you prefer—but you must do so clearly. You must write your essay using a **soft lead No. 2 pencil** (not a mechanical pencil or ink pen) and only on the lined pages in the answer folder. You may not need all the lined pages, but to ensure you have enough room to finish, do not skip lines.

### ***Make corrections clear.***

If you make corrections by using erasures or cross-outs, do so thoroughly and legibly. You may write corrections or additions neatly between the lines of your essay, but do not write in the margins of the lined pages.

## Preparing for Test Day

Although what you know will determine how well you do on the ACT, your attitudes, emotions, and physical state may also influence your performance. The following tips will help you do your best:

- Be confident in your ability to do well on the ACT. You can do well!
- Be prepared to work hard.
- Know what to expect on test day. Familiarize yourself with the information in this booklet, and at **www.actstudent.org**.

NOTE: Most procedures in this booklet refer to testing on an established ACT test date at an ACT test center. Procedures may differ slightly if you test at another location. For example, for most administrations, you won't normally be allowed to use scratch paper because each page of the Mathematics Test has a blank column that you can use for scratch work.

- Take the practice tests in the exact order they are presented. Review your responses so you will feel comfortable about the approaching test day.
- Prepare well in advance for the tests. Do not leave preparation to the last minute.
- Get plenty of rest the night before the tests so you will be in good physical condition for taking them.
- Bring the following items with you to the test center:
  1. Your test center admission ticket (if you are testing on an established ACT test date).
  2. Acceptable identification. Your admission ticket is **not** identification. See details on your admission ticket or at **www.actstudent.org**. If you do not present acceptable identification at the time of check-in, you will not be admitted to test (you will then have to pay a Test Date Change fee to transfer your registration to a different test date). If you have any questions about acceptable ID, call ACT Test Administration (319/337-1510) *before* test day.
  3. Sharpened soft lead No. 2 pencils with good erasers (no mechanical pencils; no ink, ballpoint, or felt-tip pens). Do **not** bring highlight pens or any other writing instruments; you will not be allowed to use them. If you have registered to take the ACT Plus Writing, your essay **must** also be completed with a soft lead No. 2 pencil.
  4. A watch to pace yourself. Do **not** bring a watch with an alarm function. You will not be allowed to set an alarm because it will disturb other students. If your alarm sounds during testing, you will be dismissed and your answer document will not be scored. Your supervisor will announce when you have five minutes remaining on each test.
  5. A permitted calculator for the Mathematics Test, if you wish to use one. (See shaded section on page 5.)



For students testing on established ACT test dates:

- If you register online, print your ticket from your ACT Web account. If you submit a registration folder, look for your admission ticket in the mail about 2 weeks later.
- If you misplace your admission ticket or have not received it by 10 days before the test date, log in to your ACT Web account to print a copy, or call ACT Registration at 319/337-1270 for assistance.
- Check your admission ticket for your Test Option and the location of the test center to which you have been assigned. Pay attention to any special messages on your ticket such as what building to go to, what entrance to use, where to park, etc. If you are unfamiliar with the location, do a practice run to see how to get there and how much travel time you will need to arrive on time.
- Plan to arrive by the time listed on your admission ticket. If you arrive earlier than 7:45 a.m., you will probably have to wait outside until testing personnel have completed their arrangements.
- Be prepared for testing to start after all examinees present at 8:00 a.m. have been checked in and seated.
- Dress comfortably. To conserve energy, your test center may be considerably warmer or cooler on weekends than during the week. Please dress so that you will be comfortable in a variety of temperatures.

## 2 Strategies for Taking the ACT Tests

The ACT measures the knowledge, understanding, and skills that you have acquired throughout your education. Although the sum total of what a person has learned cannot easily be changed, your performance in a specific area can be affected by adequate preparation, especially if it has been some time since you have taken a course in that area.

There are three strategies that can help you to prepare yourself for the content included in the ACT:

### **Familiarize yourself with the content of the ACT tests.**

Review the information about the tests that is provided on the following pages. Note which content areas make up a large proportion of the tests and which do not. The specific topics included in each content area are examples of possible topics; they do not include all of the possibilities.

### **Refresh your knowledge and skills in the content areas.**

Review those content areas you have studied but are not fresh in your mind. Spend your time refreshing your knowledge and skills in the content areas that make up large portions of the tests.

### **Use of Calculators on the ACT Mathematics Test**

It is your responsibility to bring a permitted calculator. We regularly update information about which calculators are **prohibited**. To be certain your calculator will be permitted on test day, visit [www.actstudent.org](http://www.actstudent.org) or call 800/498-6481 for a recorded message. If you use a prohibited calculator, you will be dismissed and your answer document will not be scored.

You may use a calculator on the ACT Mathematics Test (but not on any of the other tests in the ACT). You are **not required** to use a calculator. All the problems can be solved without a calculator. If you regularly use a calculator in your mathematics work, you may wish to use one you are familiar with as you take the Mathematics Test. Using a more powerful, but unfamiliar, calculator is not likely to give you an advantage over using the kind you normally use.

You may use any four-function, scientific, or graphing calculator, unless it has features described in the **Prohibited** list. For models on the **Permitted with Modification** list, you will be required to modify some of the calculator's features.

#### **Prohibited Calculators**

The following types of calculators are **prohibited**:

- calculators with built-in computer algebra systems—*Prohibited calculators in this category include:*
  - Texas Instruments: All model numbers that begin with **TI-89** or **TI-92**; and the **TI-Nspire CAS**—Note: The TI-Nspire (non-CAS) is permitted.
  - Hewlett-Packard: **HP 48GII** and all model numbers that begin with **HP 40G**, **HP 49G**, or **HP 50G**
  - Casio: **Algebra fx 2.0**, **ClassPad 300**, and all model numbers that begin with **CFX-9970G**
- handheld, tablet, or laptop computers, including PDAs
- electronic writing pads or pen-input devices—Note: The Sharp EL 9600 is permitted.

- calculators built into cell phones or any other electronic communication devices
- calculators with a typewriter keypad (letter keys in QWERTY format)—*Note: Letter keys **not** in QWERTY format are permitted.*

#### **Calculators Permitted with Modification**

The following types of calculators are **permitted, but only after they are modified as noted**:

- calculators with paper tape—*Remove the tape.*
- calculators that make noise—*Turn off the sound.*
- calculators with an infrared data port—*Completely cover the infrared data port with heavy opaque material such as duct tape or electrician's tape.*
- calculators that have power cords—*Remove all power/electrical cords.*

#### **On Test Day**

Be sure your calculator is working and has reliable batteries. You may bring a backup calculator and extra batteries to the test center. Testing staff will **not** supply batteries or calculators. You will **not** be allowed to share calculators during testing.

Testing staff will check your calculator to verify it is permitted, and they will monitor your use of your calculator to ensure that you:

- use it only during the Mathematics Test;
- use your backup calculator only after it has been checked by a member of the testing staff
- do not share your calculator; and
- do not store test materials in your calculator's memory.

If your calculator has characters one inch high or larger, or a raised display, testing staff may seat you where no other examinee can see your calculator.



***Identify the content areas you have not studied.***

If unfamiliar content areas make up major portions of the tests, consider taking coursework to help you gain knowledge and skills in these areas before you take the ACT. Because the ACT measures knowledge and skills acquired over a period of time, it is unlikely that a “cram” course covering material that is unfamiliar to you will help you improve your scores. Longer-term survey courses will be most helpful to you, because they aim to improve your knowledge through sustained learning and practice.

## **ACT English Test**

The ACT English Test is a 75-question, 45-minute test that measures your understanding of the conventions of standard written English (punctuation, grammar and usage, and sentence structure) and of rhetorical skills (strategy, organization, and style). Spelling, vocabulary, and rote recall of rules of grammar are not tested. The test consists of five essays, or passages, each of which is accompanied by a sequence of multiple-choice test questions. Different passage types are employed to provide a variety of rhetorical situations. Passages are chosen not only for their appropriateness in assessing writing skills but also to reflect students' interests and experiences.

Some questions refer to underlined portions of the passage and offer several alternatives to the underlined portion. You must decide which choice is most appropriate in the context of the passage. Some questions ask about an underlined portion, a section of the passage, or the passage as a whole. You must decide which choice best answers the question posed. Many questions offer “NO CHANGE” to the passage as one of the choices. The questions are numbered consecutively. Each question number refers to a correspondingly numbered portion underlined in the passage or to a corresponding numeral in a box located at the appropriate point in the passage.

Three scores are reported for the ACT English Test: a total test score based on all 75 questions, a subscore in Usage/Mechanics based on 40 questions, and a subscore in Rhetorical Skills based on 35 questions.

### **Tips for Taking the ACT English Test**

***Pace yourself.***

The ACT English Test contains 75 questions to be completed in 45 minutes. If you spend 1½ minutes skimming through each passage before responding to the questions, then you will have 30 seconds to answer each question. If possible, spend less time on each question and use the remaining time allowed for this test to review your work and return to the questions on this test that were most difficult for you.

***Be aware of the writing style used in each passage.***

The five passages cover a variety of topics and are written in a variety of styles. It is important that you take into account the writing style used in each passage when you respond to the questions. In responding to a question, be sure to understand the context of the question. Consider how the sentence containing an underlined portion fits in with the surrounding sentences and into the passage as a whole.

***Examine the underlined portions of the passage.***

Before responding to a question with an underlined portion, carefully examine what is underlined in the text. Consider the elements of writing that are included in each underlined portion. Some questions will ask you to base your decision on some specific element of writing, such as the tone or emphasis the text should convey. Some questions will ask you to choose the alternative to the underlined portion that is NOT or LEAST acceptable. The answer choices for each question will contain changes in one or more of those elements of writing.

***Be aware of questions with no underlined portions.***

You will be asked some questions about a section of the passage or about the passage as a whole, in light of a given rhetorical situation. Questions of this type are often identified by a question number in a box located at the appropriate point in the passage. Questions asking global questions about the entire passage are placed at the end of the passage and introduced by a horizontal box enclosing the following instruction: “Questions \_\_\_\_ and \_\_\_\_ ask about the preceding passage as a whole.”

***Note the differences in the answer choices.***

Many of the questions in the test will involve more than one aspect of writing. Examine each answer choice and how it differs from the others. Be careful not to select an answer that corrects one error but causes a different error.

***Determine the best answer.***

Two approaches can be taken to determine the best answer to a question in which you are to choose the best alternative to an underlined portion. In the first approach, you can reread the sentence or sentences, substituting each of the possible answer choices for the underlined portion to determine the best choice. In the second approach, you can decide how the underlined portion might best be phrased in standard written English or in terms of the particular question posed. If you think the underlined portion is the best answer, you should select “NO CHANGE.” If not, you should check to see whether your phrasing is one of the other answer choices. If you do not find your phrasing, you should choose the best of the answers presented. For questions cued by a number in a box, you must decide which choice is most appropriate in terms of the question posed or the stated rhetorical situation.

***Reread the sentence, using your selected answer.***

Once you have selected the answer you feel is best, reread the corresponding sentence(s) of the passage, inserting your selected answer at the appropriate place in the text to make sure it is the best answer within the context of the passage.

### **Content Covered by the ACT English Test**

Six elements of effective writing are included in the English Test: punctuation, grammar and usage, sentence structure, strategy, organization, and style. The questions covering punctuation, grammar and usage, and sentence structure make up the Usage/Mechanics subscore. The questions covering strategy, organization, and style make up the Rhetorical Skills subscore. A brief description and the approximate percentage of the test devoted to each element of effective writing are given on the next page.

## USAGE/MECHANICS

*Punctuation (13%).* Questions in this category test your knowledge of the conventions of internal and end-of-sentence punctuation, with emphasis on the relationship of punctuation to meaning (for example, avoiding ambiguity, indicating appositives).

*Grammar and Usage (16%).* Questions in this category test your understanding of agreement between subject and verb, between pronoun and antecedent, and between modifiers and the word modified; verb formation; pronoun case; formation of comparative and superlative adjectives and adverbs; and idiomatic usage.

*Sentence Structure (24%).* Questions in this category test your understanding of relationships between and among clauses, placement of modifiers, and shifts in construction.

## RHETORICAL SKILLS

*Strategy (16%).* Questions in this category test how well you develop a given topic by choosing expressions appropriate to an essay's audience and purpose; judging the effect of adding, revising, or deleting supporting material; and judging the relevancy of statements in context.

*Organization (15%).* Questions in this category test how well you organize ideas and choose effective opening, transitional, and closing sentences.

*Style (16%).* Questions in this category test how well you choose precise and appropriate words and images, maintain the level of style and tone in an essay, manage sentence elements for rhetorical effectiveness, and avoid ambiguous pronoun references, wordiness, and redundancy.

## ACT Mathematics Test

**You may use a calculator on the Mathematics Test. See page 5 for details about permitted and prohibited calculators.**

The ACT Mathematics Test is a 60-question, 60-minute test designed to assess the mathematical skills students have typically acquired in courses taken up to the beginning of grade 12. The test presents multiple-choice questions that require you to use reasoning skills to solve practical problems in mathematics. Most questions are discrete, but on occasion some may belong to sets of several questions (e.g., several questions based on the same graph or chart). Knowledge of basic formulas and computational skills are assumed as background for the problems, but recall of complex formulas and extensive computation is not required. The material covered on the test emphasizes the major content areas that are prerequisites to successful performance in entry-level courses in college mathematics.

Four scores are reported for the ACT Mathematics Test: a total test score based on all 60 questions, a subscore in Pre-Algebra/Elementary Algebra based on 24 questions, a subscore in Intermediate Algebra/Coordinate Geometry based on 18 questions, and a subscore in Plane Geometry/Trigonometry based on 18 questions.

## Tips for Taking the ACT Mathematics Test

### ***Pace yourself.***

The ACT Mathematics Test contains 60 questions to be completed in 60 minutes. You have an average of 1 minute per question. If possible, spend less time on each question and use the remaining time allowed for this test to review your work and return to the questions on this test that were most difficult for you.

### ***If you use a calculator, use it wisely.***

Remember, all of the mathematics problems can be solved without using a calculator. In fact, some of the problems are best done without a calculator. Use good judgment in deciding when, and when not, to use a calculator. For example, for some problems you may wish to do scratch work to clarify your thoughts on the question before you begin using a calculator to do computations. For many problems, you may not want to use a calculator.

### ***Solve the problem.***

For working out the solutions to the problems, you may usually do scratch work in the space provided in the test booklet, or you will be given scratch paper to use. You may wish to glance over the answer choices after reading the questions. However, working backwards from the answer choices provided can take a lot of time and may not be effective.

### ***Locate your solution among the answer choices.***

Once you have solved the problem, look for your answer among the choices. If your answer is not included among the choices, carefully reread the problem to see whether you missed important information. Pay careful attention to the question being asked. If an equation is to be selected, check to see whether the equation you think is best can be transformed into one of the answer choices provided.

### ***Make sure you answer the question.***

The solutions to many questions in the test will involve several steps. Make sure your answer includes all of the necessary steps. Frequently, questions include answer choices that are based on incomplete solutions.

### ***Make sure your answer is reasonable.***

Sometimes an error in computation will result in an answer that is not practically possible for the situation described. Always think about your answer to determine whether it is reasonable.

### ***Check your work.***

You may arrive at an incorrect solution by making common errors in the problem-solving process. Thus, if there is time available before the end of the Mathematics Test, it is important that you reread the questions and check your answers to make sure they are correct.

## Content Covered by the ACT Mathematics Test

Six content areas are included in the Mathematics Test: pre-algebra, elementary algebra, intermediate algebra, coordinate geometry, plane geometry, and trigonometry. The questions covering pre-algebra and elementary algebra make up the Pre-Algebra/Elementary Algebra subscore. The questions covering intermediate algebra and coordinate geometry make up the Intermediate Algebra/Coordinate Geometry subscore. The questions

covering plane geometry and trigonometry make up the Plane Geometry/Trigonometry subscore. A brief description and the approximate percentage of the test devoted to each content area are given below.

#### PRE-ALGEBRA/ELEMENTARY ALGEBRA

*Pre-Algebra (23%).* Questions in this content area are based on basic operations using whole numbers, decimals, fractions, and integers; place value; square roots and approximations; the concept of exponents; scientific notation; factors; ratio, proportion, and percent; linear equations in one variable; absolute value and ordering numbers by value; elementary counting techniques and simple probability; data collection, representation, and interpretation; and understanding simple descriptive statistics.

*Elementary Algebra (17%).* Questions in this content area are based on properties of exponents and square roots, evaluation of algebraic expressions through substitution, using variables to express functional relationships, understanding algebraic operations, and the solution of quadratic equations by factoring.

#### INTERMEDIATE ALGEBRA/COORDINATE GEOMETRY

*Intermediate Algebra (15%).* Questions in this content area are based on an understanding of the quadratic formula, rational and radical expressions, absolute value equations and inequalities, sequences and patterns, systems of equations, quadratic inequalities, functions, modeling, matrices, roots of polynomials, and complex numbers.

*Coordinate Geometry (15%).* Questions in this content area are based on graphing and the relations between equations and graphs, including points, lines, polynomials, circles, and other curves; graphing inequalities; slope; parallel and perpendicular lines; distance; midpoints; and conics.

#### PLANE GEOMETRY/TRIGONOMETRY

*Plane Geometry (23%).* Questions in this content area are based on the properties and relations of plane figures, including angles and relations among perpendicular and parallel lines; properties of circles, triangles, rectangles, parallelograms, and trapezoids; transformations; the concept of proof and proof techniques; volume; and applications of geometry to three dimensions.

*Trigonometry (7%).* Questions in this content area are based on understanding trigonometric relations in right triangles; values and properties of trigonometric functions; graphing trigonometric functions; modeling using trigonometric functions; use of trigonometric identities; and solving trigonometric equations.

### ACT Reading Test

The ACT Reading Test is a 40-question, 35-minute test that measures your reading comprehension. The test questions ask you to derive meaning from several texts by (1) referring to what is explicitly stated and (2) reasoning to determine implicit meanings. Specifically, questions will ask you to use referring and reasoning skills to determine main ideas; locate and interpret significant details; understand sequences of events; make comparisons;

comprehend cause-effect relationships; determine the meaning of context-dependent words, phrases, and statements; draw generalizations; and analyze the author's or narrator's voice and method. The test comprises four prose passages that are representative of the level and kinds of text commonly encountered in first-year college curricula. Each passage is preceded by a heading that identifies what type of passage it is (for example, "Prose Fiction"), names the author, and may include a brief note that helps in understanding the passage. Each passage is accompanied by a set of multiple-choice test questions. These questions do not test the rote recall of facts from outside the passage, isolated vocabulary items, or rules of formal logic.

Three scores are reported for the ACT Reading Test: a total test score based on all 40 questions, a subscore in Social Studies/Sciences reading skills (based on the 20 questions on the social studies and natural sciences passages), and a subscore in Arts/Literature reading skills (based on the 20 questions on the prose fiction and humanities passages).

#### Tips for Taking the ACT Reading Test

##### ***Pace yourself.***

The ACT Reading Test contains 40 questions to be completed in 35 minutes. If you spend 2–3 minutes reading each passage, then you will have about 35 seconds to answer each question. If possible, spend less time on the passages and the questions and use the remaining time allowed for this test to review your work and return to the questions on this test that were most difficult for you.

##### ***Read the passage carefully.***

Before you begin answering a question, read the entire passage thoroughly. It is important that you read every sentence rather than skim the text. Be conscious of relationships between or among ideas. You may want to make notes about important ideas in the passage either in the test booklet or on scratch paper, if provided.

##### ***Refer to the passage when answering the questions.***

Answers to some of the questions will be found by referring to what is explicitly stated in the text. Other questions will require you to determine implicit meanings and to draw conclusions, comparisons, and generalizations. Refer to the passage before you answer any question.

#### Content Covered by the ACT Reading Test

The Reading Test is based on four types of reading selections: the social studies, the natural sciences, prose fiction, and the humanities. A subscore in Social Studies/Sciences reading skills is based on the questions on the social studies and the natural sciences passages, and a subscore in Arts/Literature reading skills is based on the questions on the prose fiction and humanities passages. A brief description and the approximate percentage of the test devoted to each type of reading selection are given below.

*Social Studies (25%).* Questions in this category are based on passages in the content areas of anthropology, archaeology, biography, business, economics, education, geography, history, political science, psychology, and sociology.



*Natural Sciences (25%).* Questions in this category are based on passages in the content areas of anatomy, astronomy, biology, botany, chemistry, ecology, geology, medicine, meteorology, microbiology, natural history, physiology, physics, technology, and zoology.

*Prose Fiction (25%).* Questions in this category are based on intact short stories or excerpts from short stories or novels.

*Humanities (25%).* Questions in this category are based on passages from memoirs and personal essays and in the content areas of architecture, art, dance, ethics, film, language, literary criticism, music, philosophy, radio, television, and theater.

## ACT Science Test

The ACT Science Test is a 40-question, 35-minute test that measures the interpretation, analysis, evaluation, reasoning, and problem-solving skills required in the natural sciences.

The test presents seven sets of scientific information, each followed by a number of multiple-choice test questions. The scientific information is conveyed in one of three different formats: data representation (graphs, tables, and other schematic forms), research summaries (descriptions of several related experiments), or conflicting viewpoints (expressions of several related hypotheses or views that are inconsistent with one another). The questions require you to recognize and understand the basic features of, and concepts related to, the provided information; to examine critically the relationship between the information provided and the conclusions drawn or hypotheses developed; and to generalize from given information to gain new information, draw conclusions, or make predictions.

You are **not permitted** to use a calculator on the ACT Science Test.

One score is reported for the ACT Science Test: a total test score based on all 40 questions.

### Tips for Taking the ACT Science Test

#### ***Pace yourself.***

The ACT Science Test contains 40 questions to be completed in 35 minutes. If you spend about 2 minutes reading each passage, then you will have about 30 seconds to answer each question. If possible, spend less time on the passages and the questions and use the remaining time allowed for this test to review your work and return to the questions on this test that were most difficult for you.

#### ***Read the passage carefully.***

Before you begin answering a question, read the scientific material provided. It is important that you read the entire text and examine any tables, graphs, or figures. You may want to make notes about important ideas in the information provided, either in the test booklet or on scratch paper, if provided. Some of the information sets will describe experiments. You should consider the experimental design, including the controls and variables, because questions are likely to address this component of scientific research.

#### ***Note different viewpoints in passages.***

Some material will present conflicting points of view, and the questions will ask you to distinguish among the various

viewpoints. It may be helpful for you to make notes summarizing each viewpoint, either next to that section in your test booklet or on scratch paper, if provided. For questions that ask you to compare viewpoints, these notes will help you answer more quickly.

### Content Covered by the ACT Science Test

The content of the Science Test includes biology, chemistry, physics, and the Earth/space sciences (for example, geology, astronomy, and meteorology). Advanced knowledge in these subjects is not required, but knowledge acquired in general, introductory science courses is needed to answer some of the questions. The test emphasizes scientific reasoning skills over recall of scientific content, skill in mathematics, or reading ability. The scientific information is conveyed in one of three different formats.

*Data Representation (38%).* This format presents graphic and tabular material similar to that found in science journals and texts. The questions associated with this format measure skills such as graph reading, interpretation of scatterplots, and interpretation of information presented in tables.

*Research Summaries (45%).* This format provides descriptions of one or more related experiments. The questions focus upon the design of experiments and the interpretation of experimental results.

*Conflicting Viewpoints (17%).* This format presents expressions of several hypotheses or views that, being based on differing premises or on incomplete data, are inconsistent with one another. The questions focus upon the understanding, analysis, and comparison of alternative viewpoints or hypotheses.

## ACT Writing Test (Optional)

If you register for the ACT Plus Writing, you will take the ACT Writing Test (which must be completed in English) **after** you complete the four multiple-choice tests. Taking the Writing Test will **not** affect your scores on the multiple-choice tests or your Composite score. Rather, you will receive two additional scores: a Combined English/Writing score on a scale of 1 through 36 and a Writing subscore on a scale of 2 through 12. You will also receive some comments on your essay. In addition, an image of your essay will be available to your high school and the colleges to which we report your scores from that test date.

The ACT Writing Test is a 30-minute essay test that measures your writing skills—specifically those writing skills emphasized in high school English classes and in entry-level college composition courses. The test consists of one writing prompt that will define an issue and describe two points of view on that issue. You are asked to write in response to a question about your position on the issue described in the writing prompt. In doing so, you may adopt one or the other of the perspectives described in the prompt, or you may present a different point of view on the issue. Your essay score will not be affected by the point of view you take on the issue. Prompts are designed to be appropriate for response in a 30-minute timed test and to reflect students' interests and experiences.

Your essay will be evaluated on the evidence it gives of your ability to do the following:

- express judgments by taking a position on the issue in the writing prompt;
- maintain a focus on the topic throughout the essay;
- develop a position by using logical reasoning and by supporting your ideas;
- organize ideas in a logical way; and
- use language clearly and effectively according to the conventions of standard written English.

Your essay will be scored holistically—that is, on the basis of the overall impression created by all the elements of the writing. Two trained readers will score your essay, each giving it a rating from 1 (low) to 6 (high). The sum of those ratings is your Writing subscore. If the readers' ratings disagree by more than one point, a third reader will evaluate your essay and resolve the discrepancy.

### **Tips for Taking the ACT Writing Test**

#### ***Pace yourself.***

The ACT Writing Test gives you 30 minutes to read and think about the issue in the prompt, and to plan and write your essay. When asked to write a timed essay, most writers find it useful to do some planning before they write the essay, and to do a final check of the essay when it is finished. It is unlikely that you will have time to draft, revise, and recopy your essay. Therefore, taking a few minutes to plan your essay is a much better strategy than writing a first draft with the intent to copy it over for the final essay.

#### ***Prewrite.***

Some writers like to plunge right in, but this is seldom a good way to do well on a timed essay. Prewriting gets you acquainted with the issue, suggests patterns for presenting your thoughts, and gives you a little breathing room to come up with interesting ideas for introducing and concluding your essay. Before writing, then, carefully consider the prompt and make sure you understand it—reread it if you aren't sure. Decide how you want to answer the question in the prompt. Then jot down your ideas on the topic: this might simply be a list of ideas, reasons, and examples that you will use to explain your point of view on the issue. Write down what you think others might say in opposition to your point of view and think about how you would refute their argument. Think of how best to organize the ideas in your essay. You will be instructed to do your prewriting in your Writing Test booklet. You can refer back to these notes as you write the essay itself on the lined pages of your answer folder.

#### ***Write.***

Once you're ready to write your essay in the answer folder, proceed with the confidence that you have prepared well and that you will have attentive and receptive readers who are interested in your ideas. At the beginning of your essay, make sure readers will see that you understand the issue. Explain your point of view in a clear and logical way. If possible, discuss the issue in a broader context or evaluate the implications or complications of the issue. Address what others might say to refute your point of view and present a counterargument. Use specific examples. Vary the structure of your sentences, and use varied and

precise word choices. Make logical relationships clear by using transitional words and phrases. Do not wander off the topic. End with a strong conclusion that summarizes or reinforces your position.

Is it advisable to organize the essay by using a formula, like "the five-paragraph essay"? Points are neither awarded nor deducted for following familiar formulas, so feel free to use one or not as best suits your preference. Some writers find formulas stifling, other writers find them vital, and still other writers just keep them handy in the toolbox to use when needed. The exact numbers of words and paragraphs in your essay are less important than the clarity and development of your ideas. Writers who have something to say usually find that their ideas have a way of sorting themselves out at reasonable length and in the right number of paragraphs.

#### ***Review your essay.***

Take a few minutes before time is called to read over your essay. Correct any mistakes in grammar, usage, punctuation, and spelling. If you find any words that are hard to read, recopy them so your readers can read them easily. Make any corrections and revisions neatly, between the lines (but not in the margins). Your readers take into account that you had only 30 minutes to compose and write your essay. Within that time limit, try to make your essay as polished as you can.

#### ***Practice.***

There are many ways to prepare for the ACT Writing Test. You may be surprised that these include reading newspapers and magazines, listening to news analyses on television or radio, and participating in discussions and debates about issues and problems. These activities help you become more familiar with current issues, with different perspectives on those issues, and with strategies that skilled writers and speakers use to present their points of view.

Of course, one of the best ways to prepare for the ACT Writing Test is to practice writing different kinds of texts, for different purposes, with different audiences in mind. The writing you do in your English classes will help you. So will practice in writing essays, stories, poems, plays, editorials, reports, letters to the editor, a personal journal, or other kinds of writing that you do on your own. Because the ACT Writing Test asks you to explain your perspective on an issue in a convincing way, writing opportunities like editorials or letters to the editor of a newspaper are especially helpful. Practicing a variety of different kinds of writing will help make you a versatile writer able to adjust to different writing occasions and assignments.

It is also a good idea to practice writing within a time limit. This will help build skills that are important in college-level learning and in the world of work. Taking the practice ACT Writing Test in this booklet will give you a good idea of what timed writing is like and how much additional practice you may need. You might want to take the practice ACT Writing Test even if you do not plan to register for it, because all the writing you do contributes to your skill in expressing yourself.

### Content Covered by the ACT Writing Test

Writing is where form and content come together. To state that more precisely, writing is where *you* put form and content together. On the ACT Writing Test, we provide the “prompt”—an issue that has been chosen for its appropriateness in a 30-minute test and for its relevance to students’ interests and experiences. The prompt defines the topic and asks you to focus on that topic in your essay. But the “content” of your essay—the arguments and explanations, the analysis and examples, in all their details—is provided by you. By applying your writing skills to shaping that content, you also provide the “form” of your essay. So, with regard to the content covered by the Writing Test, you are the author.

## 3 What to Expect on Test Day

### Reporting Time

For established test dates, you must report to the test center by the time stated on your admission ticket, normally 8:00 a.m. If you are late, you may not be admitted to test. If your admission ticket does not list a specific room, test center staff or posted signs will direct you to your test room.

### Identification Required

**At check-in, you will be required to show acceptable ID.**

See ID requirements on your admission ticket, at [www.actstudent.org](http://www.actstudent.org), or in *Registering for the ACT*. You will also need to bring your admission ticket to complete your answer document correctly.

### Dos and Don'ts

In the test room, the supervisor or proctor will direct you to a seat. If you need a left-handed desk, tell your supervisor as you enter. Do not leave the test room after you have been admitted. Only pencils, erasers, a permitted calculator (for the Mathematics Test only), and your admission ticket will be allowed on your desk. You will be required to put all other personal belongings away. You will not be allowed to have scratch paper, books, dictionaries, notes or other aids, highlighters, colored pens or pencils, mechanical pencils, ink pens, correction fluid, reading material, or any electronic devices other than a permitted calculator. Examples of prohibited items include: timer, beeper, cell phone, media player, PDA, headphones, camera. You may not use tobacco in any form or have food or drink (including water) in the test room. You must abide by the rules of the test center.

Try to relax just before beginning the tests. Take a few deep breaths, tense and relax your muscles, and think about pleasant things.

### Test Preliminaries

Testing will begin as soon as all examinees present at 8:00 a.m. are checked in and seated. Listen carefully to all directions read by your supervisor. Ask questions if you do not understand what you are to do. It is very important that

you *follow all directions* carefully. For instance, if you do not copy the Matching Information from your admission ticket onto your answer document accurately, or fill in the correct ovals, your answer document will not match your registration record—and your scores will be delayed up to 8 weeks.

You will receive a different answer document depending on which Test Option you registered to take. Make sure the answer document you receive matches the Test Option you intend to take.

After you have completed page 1 of the answer document, you will receive a test booklet. You will be told to read the directions printed on the cover, then asked to write the booklet number and test form at the top of page 2 of the answer document. It is extremely important that you fill in the correct ovals for your test booklet number and for the test form you are taking because these determine which answer key will be used to score your answer document. The supervisor will then tell you when to break the seal, open your test booklet, and begin work. If you are taking the ACT Plus Writing, you will receive a Writing Test booklet only after you have completed the four multiple-choice tests.

### Taking the Tests

As you are working, keep your eyes on your own test booklet and answer document. If you have a question, raise your hand, but do not look around. Please remember that as you take the tests you may not use information or materials that cause you to obtain a test score that misrepresents what you have learned.

It is important that you understand what is considered prohibited behavior on the ACT. If you are involved in **any** of the actions listed below, you will be dismissed and your answer document will not be scored.

Prohibited behaviors include:

- filling in or altering any ovals or continuing to write the essay after time is called on each test (You must put your pencil down immediately when time is called.)
- looking at another examinee's test booklet or answer document
- giving or receiving assistance
- looking back at a test on which time has been called
- looking ahead in the test booklet
- using highlight pens, colored pens or pencils, notes, dictionaries, or other aids
- using a prohibited calculator
- using any device to share or exchange information at any time during testing or during breaks (**all** electronic devices, including cell phones, must be turned off from the time you are admitted to test until you are dismissed after testing concludes)
- sharing a calculator with another examinee
- using a calculator on any test other than the Mathematics Test
- attempting to remove test materials, including questions or answers, from the test room by any means
- not following instructions or abiding by the rules of the test center

- exhibiting confrontational, threatening, or unruly behavior
- creating a disturbance or allowing an alarm or phone to sound in the test room

If you engage in **any** of these prohibited behaviors, you will be dismissed from the test center and your answer document will **not** be scored.

If you finish a test before time is called, review your work on that test. Do **not** return to a previous test and do not work ahead. If you are satisfied with your responses, place your answer document inside your test booklet and close the cover. Sit quietly until your supervisor gives you additional instructions.

You will have a 10 to 15-minute break after the first two tests. Do not leave the building during the break because some buildings have automatic locking doors, and you may be locked out. You must ask permission to leave the room during testing to go to the restroom; you will not be allowed to make up lost time. If you are taking the ACT Plus Writing, you will also have a brief break after Test 4 in which to relax and to sharpen your pencils.

On certain test dates, ACT administers test questions for developmental purposes. Responses to these questions do not affect your scores.

At the conclusion of testing, you will be asked to sign a statement and copy a certification in your own handwriting (do not print) to verify truthful identification of yourself. You will be required to sit quietly until you are dismissed. After all answer documents and test booklets have been collected and counted, your supervisor will dismiss you.

## Special Situations

If, for any reason, you have to leave the test center before completing all your tests, you must decide whether or not you want your answer document scored and inform your supervisor of your decision. If you fail to do so, your answer document will be scored. If you decide *after* you have completed all your tests that you do not want your answer documents scored, tell your supervisor *before* you leave the test center. You need not give a reason.

Once you break the seal on your multiple-choice test booklet, you cannot request a Test Date Change. If you want to take the ACT again, you will have to reregister. See [www.actstudent.org](http://www.actstudent.org) or *Registering for the ACT*. Once you begin filling out your answer document, you cannot request a Test Option Change on that test date (i.e., you may not change from ACT Plus Writing to the ACT or the reverse on test day).

You may not receive scores from more than one test date per national or international administration (Saturday, non-Saturday, or rescheduled test date arranged by ACT). If you are admitted and allowed to test, you will receive **ONLY** the scores from your first test date.

## Test Information Release

On certain national test dates, you may order (for an additional fee) a copy of the test questions, a copy of your answers, a list of correct answers, and scoring instructions.

This service is not available for all test dates or for other types of testing. If you want it, check [www.actstudent.org](http://www.actstudent.org) or *Registering for the ACT* to see which test dates offer this service and register for one of those dates.

# 4 Taking the Practice Tests

Taking the practice tests can help you become familiar with the ACT. It will be most helpful if you take the tests under conditions that are as similar as possible to those you will experience on test day. The following tips will help you make the most of the practice tests:

- The four multiple-choice tests require a total of 2 hours and 55 minutes. Take them in order in one sitting, with a 10 to 15-minute break between Tests 2 and 3. (If you are taking the Writing Test, you may also take a 5-minute break after Test 4.)
- Sit at a desk with good lighting. You will need sharpened No. 2 pencils with good erasers. You may not use highlight pens or correction fluid. Remove all books and other aids from your desk. On test day, you will not be allowed to use references or notes. For most administrations, you won't need scratch paper because each page of the Mathematics Test has a blank column that you can use for scratch work.
- If you plan to use a calculator on the Mathematics Test, review the information about permitted and prohibited calculators on page 5.
- Use a digital timer or clock to time yourself on each practice test. Set your timer for five minutes less than the allotted time for each test so you can get used to the verbal announcement of five minutes remaining. (Students approved for extended time should set a timer for 60-minute announcements up to the total time allowed—5 hours for the ACT (No Writing), or 5 hours and 45 minutes for the ACT Plus Writing.)
- Give yourself only the time allowed for each test.
- Detach and use the sample multiple-choice answer document on pages 73–74.
- Read the general test directions on the first page of the practice multiple-choice tests. These are the same directions that will appear on your test booklet on test day. After you have read the directions, start your timer and begin with Test 1. Continue through Test 4, taking a 10 to 15-minute break between Tests 2 and 3. If you do not plan to take the ACT Plus Writing, score your multiple-choice tests using the information beginning on page 59.
- If you plan to take the ACT Plus Writing, take a 5-minute break after Test 4. Then read the directions on the first page of the practice ACT Writing Test (page 57). These are the same directions that will appear on your test booklet on test day. After you have read the directions, start your timer, then carefully read the prompt on page 58. After you have considered what the prompt is asking you to do, use scratch paper to plan your essay and then write your essay in the lined pages (75–78) on the answer document. When you have finished, score your essay using the information on pages 66–72.



## Practice Multiple-Choice Tests

Your Signature (do not print): \_\_\_\_\_

Print Your Name Here: \_\_\_\_\_

Your Date of Birth:

<input type="text"/>	-	<input type="text"/>	-	<input type="text"/>	<input type="text"/>
Month		Day		Year	

# Form 0661C



# The ACT<sup>®</sup>

## 2008 | 2009

## Directions

This booklet contains tests in English, Mathematics, Reading, and Science. These tests measure skills and abilities highly related to high school course work and success in college. ***CALCULATORS MAY BE USED ON THE MATHEMATICS TEST ONLY.***

The questions in each test are numbered, and the suggested answers for each question are lettered. On the answer document, the rows of ovals are numbered to match the questions, and the ovals in each row are lettered to correspond to the suggested answers.

For each question, first decide which answer is best. Next, locate on the answer document the row of ovals numbered the same as the question. Then, locate the oval in that row lettered the same as your answer. Finally, fill in the oval completely. Use a soft lead pencil and make your marks heavy and black. ***DO NOT USE A BALLPOINT PEN.***

Mark only one answer to each question. If you change your mind about an answer, erase your first mark thoroughly before marking your new answer. For each question, make certain that you mark in the row of ovals with the same number as the question.

Only responses marked on your answer document will be scored. Your score on each test will be based only on the number of questions you answer correctly during the time allowed for that test. You will ***NOT*** be penalized for guessing. ***IT IS TO YOUR ADVANTAGE TO ANSWER EVERY QUESTION EVEN IF YOU MUST GUESS.***

You may work on each test ***ONLY*** when your test supervisor tells you to do so. If you finish a test before time is called for that test, you should use the time remaining to reconsider questions you are uncertain about in that test. You may ***NOT*** look back to a test on which time has already been called, and you may ***NOT*** go ahead to another test. To do so will disqualify you from the examination.

Lay your pencil down immediately when time is called at the end of each test. You may ***NOT*** for any reason fill in or alter ovals for a test after time is called for that test. To do so will disqualify you from the examination.

Do not fold or tear the pages of your test booklet.

**DO NOT OPEN THIS BOOKLET  
UNTIL TOLD TO DO SO.**



P.O. BOX 168  
IOWA CITY, IA 52243-0168

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1



1

## ENGLISH TEST

45 Minutes—75 Questions

**DIRECTIONS:** In the five passages that follow, certain words and phrases are underlined and numbered. In the right-hand column, you will find alternatives for the underlined part. In most cases, you are to choose the one that best expresses the idea, makes the statement appropriate for standard written English, or is worded most consistently with the style and tone of the passage as a whole. If you think the original version is best, choose “NO CHANGE.” In some cases, you will find in the right-hand column a question about the underlined part. You are to choose the best answer to the question.

You will also find questions about a section of the passage, or about the passage as a whole. These questions do not refer to an underlined portion of the passage, but rather are identified by a number or numbers in a box.

For each question, choose the alternative you consider best and fill in the corresponding oval on your answer document. Read each passage through once before you begin to answer the questions that accompany it. For many of the questions, you must read several sentences beyond the question to determine the answer. Be sure that you have read far enough ahead each time you choose an alternative.

## PASSAGE I

## The Music of the O’odham

[1]

For some people, traditional American Indian music is associated and connected with high penetrating vocals <sup>1</sup> accompanied by a steady drumbeat. In tribal communities in the southwestern United States, however, one is likely to hear something similar to the polka-influenced dance music of northern Mexico. The music is called “waila.” Among the O’odham tribes of Arizona, waila has been popular for more than a century. The music is mainly <sup>2</sup>

instrumental—the bands generally consist of guitar, bass <sup>3</sup> guitar, saxophones, accordion, and drums.

[2]

Unlike some traditional tribal music, waila does not serve a religious or spiritual purpose. It is a social music that performed at weddings, birthday parties, <sup>4</sup>

1. A. NO CHANGE  
B. connected by some of them  
C. linked by association  
D. associated

2. F. NO CHANGE  
G. popular, one might say, for  
H. really quite popular for  
J. popular for the duration of
3. Which of the following alternatives to the underlined portion would NOT be acceptable?  
A. instrumental; in general, the bands  
B. instrumental, the bands generally  
C. instrumental. The bands generally  
D. instrumental; the bands generally

4. F. NO CHANGE  
G. music in which it is performed  
H. music, performing  
J. music, performed



and feasts. The word itself comes from the Spanish

5

word for dance, *baile*. Cheek to cheek, the dance is  
performed to the relaxed two-step tempo, and the bands

6

often play long past midnight. As the dancers step to the

7

music, they were also stepping in time to a sound that

8

embodies their unique history and suggests the influence

9

of outside cultures on their music. [10]

[3]

The O'odham in the 1700s first encountered the  
guitars of Spanish missionaries. In the 1850s the O'odham

11

have borrowed from the waltzes and mazurkas of  
people of European descent on their way to California.

12

5. A. NO CHANGE  
B. word, itself,  
C. word, itself  
D. word itself,
6. F. NO CHANGE  
G. Couples dance cheek to cheek to the relaxed two-step tempo,  
H. A relaxed two-step tempo, the couples dance cheek to cheek,  
J. Cheek to cheek, the two-step tempo relaxes dancing couples,
7. A. NO CHANGE  
B. play long, past,  
C. play, long past,  
D. play, long past
8. F. NO CHANGE  
G. are also stepping  
H. have also stepped  
J. will also step
9. A. NO CHANGE  
B. they're  
C. it's  
D. its'
10. At this point, the writer is considering adding the following true statement:  
The agricultural practices of the O'odham are similar to those of the Maya.  
Should the writer make this addition here?  
F. Yes, because the sentence establishes that the O'odham often borrowed ideas from other groups.  
G. Yes, because the sentence provides important information about the O'odham people.  
H. No, because the sentence is not supported by evidence of a connection between the O'odham and the Maya.  
J. No, because the sentence distracts from the paragraph's focus on waila's uses and influences.
11. All of the following would be acceptable placements for the underlined portion EXCEPT:  
A. where it is now.  
B. at the beginning of the sentence (revising the capitalization accordingly).  
C. after the word *guitars*.  
D. after the word *missionaries* (ending the sentence with a period).
12. F. NO CHANGE  
G. have been borrowing  
H. were borrowed  
J. borrowed

1

1

In the early 1900s the O’odham became acquainted with marching bands and woodwind instruments (which explains the presence of saxophones in waila).<sup>13</sup> Around this time the polka music and button accordion

played by German immigrant railroad workers; left their mark on waila.<sup>14</sup>

[4]

It should be no surprise that musicians these days are adding touches of rock, country, and reggae to waila. Some listeners fear that an American musical form may soon be lost. But the O’odham are playing waila with as much energy and devotion as ever. A unique blend of traditions, waila will probably continue changing for as long as the O’odham use it to express their own sense of harmony and tempo.

## PASSAGE II

### How Old Am I?

Many people might be surprised to learn that the American way of computing a person’s age differs from the traditional Korean way. In Korean tradition, a person is considered to be already one year old at the time of his or her birth.

As a child growing up in two cultures, I found this contest a bit confusing. When I was in the fifth grade,<sup>16</sup> was I ten or eleven years old? To add to the confusion, every New Year’s Day a person according to this Korean counting system, becomes a year<sup>17</sup>

13. Given that all of the choices are true, which one is most relevant to the focus of this paragraph?
- A. NO CHANGE
  - B. (although fiddles were once widely used in waila bands).
  - C. (even though they’re now often constructed of metal).
  - D. (which are frequently found in jazz bands also).
14. F. NO CHANGE
- G. workers
  - H. workers;
  - J. workers,

Question 15 asks about the preceding passage as a whole.

15. Upon reviewing this essay and finding that some information has been left out, the writer composes the following sentence incorporating that information:
- Those same German influences helped spawn a similar musical form in northern Mexico known as *norteño*.
- This sentence would most logically be placed after the last sentence in Paragraph:
- A. 1.
  - B. 2.
  - C. 3.
  - D. 4.

16. F. NO CHANGE
- G. change
  - H. dispute
  - J. difference
17. A. NO CHANGE
- B. person,
  - C. person;
  - D. person who,



older, regardless of his or her actual birthday.

Birthdays are important throughout the world. A person<sup>18</sup> who is sixteen years old on his or her birthday in March would become seventeen years old on the following New Year's Day, even though he or she isn't expected to turn seventeen (in "American" years) until that next birthday in March. Perhaps the celebration of New Year's Day in Korean culture is heightened because it is thought of as<sup>19</sup>

everyone's birthday party. 20

Today, after many birthdays and New Year's Days, I now find meaningful the difference I once found confusing. Otherwise, this difference points<sup>21</sup>

to significant underlying cultural values. The practice of<sup>22</sup>

advancing a person's age seems to me to reflect the value a<sup>23</sup>

society places on life experience and longevity. Their idea<sup>24</sup>

was demonstrated often when my elderly relatives, who<sup>25</sup> took pride in reminding younger folk of their "Korean

age." With great enthusiasm, they added on a year every<sup>26</sup>

18. F. NO CHANGE  
 G. Most cultures celebrate birthdays.  
 H. Birthdays focus attention on a culture's youth.  
 J. DELETE the underlined portion.

19. A. NO CHANGE  
 B. raised  
 C. lifted  
 D. lighted

20. Upon reviewing this paragraph, the writer considers deleting the preceding sentence. If the writer were to delete the sentence, the paragraph would primarily lose:  
 F. a comment on the added significance of the Korean New Year celebration.  
 G. a repetitive reminder of what happens every birthday.  
 H. a defense of the case for celebrating every birthday.  
 J. an illustration of the Korean counting system.

21. A. NO CHANGE  
 B. Though,  
 C. In fact,  
 D. Then,

22. F. NO CHANGE  
 G. on  
 H. at  
 J. DELETE the underlined portion.

23. A. NO CHANGE  
 B. persons' age  
 C. persons age  
 D. person's age,

24. F. NO CHANGE  
 G. One's  
 H. Its  
 J. This

25. A. NO CHANGE  
 B. by  
 C. while  
 D. as if

26. Which choice would most clearly communicate the elderly relatives' positive attitude toward this practice?  
 F. NO CHANGE  
 G. Duplicating an accepted practice,  
 H. Living with two birthdays themselves,  
 J. Obliging,



New Year's Day. By contrast American society has often

been described as one that values the vibrant energy of  
27

youth over the wisdom and experience gained with age. 28

After a certain age, many Americans I know would

balk, refuse, and hesitate at the idea of adding a year or  
29  
two to what they regard as their actual age.

Even something as visibly simple or natural as  
30  
computing a person's age can prove to be not so clear-cut.  
Traditions like celebrating birthdays reveal how deeply we  
are affected by the culture we live in.

27. A. NO CHANGE

B. whose

C. this

D. whom

28. If the writer were to delete the phrases "the vibrant energy of" and "the wisdom and experience gained with" from the preceding sentence, the sentence would primarily lose:

F. its personal and reflective tone.

G. an element of humor.

H. details that illustrate the contrast.

J. the preference expressed by the writer.

29. A. NO CHANGE

B. balk and hesitate

C. refuse and balk

D. balk

30. F. NO CHANGE

G. apparently

H. entirely

J. fully

### PASSAGE III

#### Wearing Jeans in School

In 1970, the school board in Pittsfield,  
New Hampshire, approved a dress code that  
prohibited students from wearing certain types  
of clothing. The school board members believed that  
31  
wearing "play clothes" to school made the students

inefficient toward their school work, while more formal  
32  
attire established a positive educational climate. When  
twelve-year-old Kevin Bannister wore a pair of blue jeans  
to school, he was sent home for violating the dress code.

31. Given that all of the choices are true, which one would best illustrate the term *dress code* as it is used in this sentence?

A. NO CHANGE

B. clothing that was inappropriate.

C. clothing, including sandals, bell-bottom pants, and "dungarees" (blue jeans).

D. clothing that is permitted in some schools today.

32. F. NO CHANGE

G. lazy and bored to tears with

H. blow off

J. lax and indifferent toward

1

1

Kevin and his parents believed that his constitutional  
rights had been violated. <sup>33</sup> The United States District  
<sup>33</sup>

Court of New Hampshire; agreed to hear Kevin's case.  
<sup>34</sup>  
 His claim was based on the notion of personal liberty—the  
 right of every individual to the control of his or her own  
 person—protected by the Constitution's Fourteenth  
 Amendment. The court agreed with Kevin that a person's  
 right for wearing clothing of his or her own choosing is,  
<sup>35</sup>  
 in fact, protected by the Fourteenth Amendment.

The court noted, however that restrictions may be justified  
<sup>36</sup>  
 in some circumstances, such as in the school setting.

So did Kevin have a right to wear blue jeans to  
 school? The court determined that the school board had  
 failed to show that wearing jeans actually inhibited the  
 educational process, which is guided by authority figures.  
<sup>37</sup>

Furthermore, the board offered no evidence to back up it's  
<sup>38</sup>

claim that such clothing created a negative educational  
<sup>39</sup>  
 environment. Certainly the school board would  
 be justified in prohibiting students from wearing  
 clothing that was unsanitary, revealing, or obscene.

33. Given that all of the choices are true, which one would  
 most effectively introduce the main idea of this para-  
 graph?

- A. NO CHANGE
- B. The principal said dungarees and blue jeans were the same thing, so Kevin should have known better.
- C. If Kevin's jeans had been dirty and torn, the principal might have been justified in expelling him.
- D. These events occurred in a time of social unrest, and emotions were running high.

34. F. NO CHANGE  
 G. Court, of New Hampshire  
 H. Court of New Hampshire  
 J. Court of New Hampshire,

35. A. NO CHANGE  
 B. of wearing  
 C. to wear  
 D. wearing

36. F. NO CHANGE  
 G. court noted, however,  
 H. court, noted however,  
 J. court noted however,

37. A. NO CHANGE  
 B. process, which has undergone changes since the 1970s.  
 C. process, a process we all know well.  
 D. process.

38. F. NO CHANGE  
 G. they're  
 H. its  
 J. ones

39. A. NO CHANGE  
 B. where  
 C. which  
 D. in which

GO ON TO THE NEXT PAGE.



The court remained unconvinced, therefore, that

40

when wearing jeans would actually impair the learning

41

process of Kevin or of his fellow classmates.

Kevin Bannister's case was significant in that it

42

was the first in the United States to address clothing

42

prohibitions of a school dress code. His challenge

42

initiated a review, of students' rights and administrative

43

responsibility in public education.

44

40. F. NO CHANGE  
G. thus,  
H. moreover,  
J. however,

41. A. NO CHANGE  
B. by wearing  
C. wearing  
D. having worn

42. Which choice would most effectively open this paragraph and convey the importance of this case?  
F. NO CHANGE  
G. Therefore, Kevin's case reminds us that you should stand up for your rights, no matter how old you are.  
H. The case for personal liberty means the right to speak up must be taken seriously by the courts.  
J. All in all, clothing is an important part of our identity.

43. A. NO CHANGE  
B. review, of students' rights,  
C. review of students' rights  
D. review of students' rights,

44. F. NO CHANGE  
G. on  
H. with  
J. about

Question 45 asks about the preceding passage as a whole.

45. Suppose the writer's goal had been to write a brief persuasive essay urging students to exercise their constitutional rights. Would this essay fulfill that goal?  
A. Yes, because the essay focuses on how Kevin encouraged other students to exercise their constitutional rights.  
B. Yes, because the essay focuses on various types of clothing historically worn by students as a freedom of expression.  
C. No, because the essay suggests that the right to wear blue jeans was not a substantial constitutional right in the 1970s.  
D. No, because the essay objectively reports on one case of a student exercising a particular constitutional right.

1

1

## PASSAGE IV

**The Case of the Trick Photographs**

You might think that Sir Arthur Conan Doyle, the writer who invented Sherlock Holmes, the most logical of detectives, would have harbored strictly logical beliefs himself. But the author entertained a variety of fanciful ideas, including a belief in the mythical beings known as fairies. Since that belief, he was fooled in 1920 by two  
<sup>46</sup>

schoolgirl cousins. 47

One day, Elsie Wright and Frances Griffiths returned from a walk in the English countryside with news that they had seen fairies. They had even taken photographs that showed several of the tiny sprites, some dancing in a ring in the grass, some fluttering in front of the girl's faces.  
<sup>48</sup> Many people were excited when they heard about

this seemingly true and factual proof of the existence of  
<sup>49</sup> fairies, but Conan Doyle was more excited than most.

To make sure that he wasn't being deceived, Conan Doyle had the original photographic plates examined by experts, however, they found no evidence of  
<sup>50</sup> double exposures. He then wrote an enthusiastic article for *Strand* magazine, being the place in which most of his  
<sup>51</sup> Sherlock Holmes stories had first appeared, and later wrote a book on the subject titled *The Coming of the Fairies*.

46. F. NO CHANGE  
 G. Because of  
 H. Concerning  
 J. For

47. If the writer were to delete the opening sentence of this paragraph (beginning the essay with "Sir Arthur Conan Doyle entertained a variety of fanciful..."), the essay would primarily lose:  
 A. information that sets up a contrast that follows.  
 B. an irrelevant but humorous digression.  
 C. information that explains Doyle's motivations.  
 D. an important description of the setting.

48. F. NO CHANGE  
 G. girls' faces.  
 H. girls faces.  
 J. girls face's.

49. A. NO CHANGE  
 B. this seemingly evident but apparent  
 C. what seemed to be an apparent  
 D. this apparent

50. F. NO CHANGE  
 G. who  
 H. which  
 J. they

51. A. NO CHANGE  
 B. in which the magazine where  
 C. in which  
 D. being where



1

1

Conan Doyle sent a copy of one of the photographs to his friend Harry Houdini, the famous magician and escape artist. Houdini, who devoted considerable effort to exposing hoaxes involving spiritualism and was

52

skeptical about the existence of supernatural beings. 53  
When Houdini remained unconvinced by the evidence, Conan Doyle became angry. Though the two

remained cordial, but their friendship was damaged

54

due to the fact that they had the disagreement.

55

Some sixty years later, an elderly Frances Griffiths

56

publicly admitted that her and her cousin had staged  
the photographs as a practical joke. Shortly after her revelation, computer enhancement revealed the hatpins that were used to prop up the cardboard-cutout fairies.

58

Scientific analysis, since photography was a new art,  
finally closed the Case of the Trick Photographs.

59

52. F. NO CHANGE

G. spiritualism, being

H. spiritualism, was

J. spiritualism and

53. If the writer were to delete the preceding sentence, the paragraph would primarily lose:

A. details that provide an explanation for the friendship between Conan Doyle and Houdini.

B. information that helps set the stage for what happens next in the essay.

C. a description of the reasons behind Houdini's skepticism about the supernatural.

D. nothing at all, since this sentence provides irrelevant information.

54. F. NO CHANGE

G. cordial and

H. cordial that

J. cordial,

55. A. NO CHANGE

B. because of the fact that they had a

C. due to the fact of their

D. by the

56. F. NO CHANGE

G. (Do NOT begin new paragraph) After some

H. (Begin new paragraph) Since some

J. (Begin new paragraph) Some

57. A. NO CHANGE

B. her cousin and herself

C. she and her cousin

D. her cousin and her

58. Which of the following alternatives to the underlined portion would NOT be acceptable?

F. that had been used

G. the girls used

H. using

J. used

59. Which choice would best tie the conclusion of this essay to its opening sentence?

A. NO CHANGE

B. of the kind a modern-day Sherlock Holmes might use,

C. which the great Houdini himself would have appreciated,

D. a methodology that was still in its infancy,

1



1

Question 60 asks about the preceding passage as a whole.

60. Suppose the writer had decided to write an essay that summarizes how beliefs in the supernatural have influenced the writing of famous authors. Would this essay fulfill the writer's goal?
- F. Yes, because the essay makes the point that Conan Doyle's belief in fairies clearly influenced his Sherlock Holmes stories.
  - G. Yes, because the essay indicates that Conan Doyle's disagreement with Houdini motivated him to write about the supernatural.
  - H. No, because the essay argues that the author's belief in fairies and the supernatural did not in any way affect his writing.
  - J. No, because the essay limits its focus to the particular events surrounding one author's reaction to evidence of the supernatural.

#### PASSAGE V

##### Her Letters to the World

Emily Dickinson, one of America's great nineteenth-century poets, was a prolific letter writer. Although her physical contact with the world was limited by caring for her invalid mother and by her own poor health, whose correspondence was

61

extensive: over one thousand letters to upwards of one hundred correspondents. These letters provide insight into her daily life and her poetry.

62

Dickinson's lifetime of letters range from playful to serious. As a young woman she wrote, of pining for a

63

valentine and of visiting the Chinese Museum in Boston. Her letters in later years reveal that she missed friends and

64

- 61. A. NO CHANGE  
B. their  
C. Dickinson's  
D. who's
- 62. F. NO CHANGE  
G. extensive, and over  
H. extensive; over  
J. extensive. Over
- 63. A. NO CHANGE  
B. (Do NOT begin new paragraph) As a young woman, she wrote  
C. (Begin new paragraph) As a young woman, she wrote,  
D. (Begin new paragraph) As a young woman, she wrote
- 64. F. NO CHANGE  
G. visiting to  
H. of her visiting to  
J. of her visiting at



encouraged them to visit. Dickinson stayed in contact with correspondents for many years. In a teasing letter to her brother, she bemoaned the fact that a big barn fire couldn't have waited until he returned to see it, since he "enjoyed

such things so much." Other letters are solemn; speaking

of relatives and friends whom had died.

Perhaps the correspondent who came to know Dickinson best through their thirty-six-year exchange of letters was Emily's friend, sister-in-law, and neighbor, Susan Gilbert Dickinson. Susan was a spiritual, social, and intellectual companion for Emily. In fact, in one letter, Emily stated that Shakespeare was the only person who had taught her more than Susan had.

One significant aspect of this relationship was: that Susan was perhaps the only reader of Emily's poems-in-progress. Letters between the two suggest that Susan might frequently have given feedback on her work, including some of her most famous

poems, composed at her home in Amherst, Massachusetts.

At one point, Emily sent a draft of her poem "Safe in Their

Alabaster Chambers" to Susan, who read the poem. As

65. Given that all of the choices are true, which one best develops the paragraph's focus on the roles that letters played in Emily Dickinson's life?

- A. NO CHANGE
- B. Her personal interests also included keen observation of the natural world around her.
- C. Though she produced volumes of letters, none were shared publicly until after her death.
- D. She enjoyed hearing their news and reflecting with them on political events.

66. F. NO CHANGE  
G. solemn they speak  
H. solemn, speaking  
J. solemn. Speaking

67. A. NO CHANGE  
B. who  
C. who they  
D. of whom

68. F. NO CHANGE  
G. was that Susan  
H. was, that Susan  
J. was that Susan,

69. A. NO CHANGE  
B. her feedback on Emily's  
C. Emily feedback on her  
D. her feedback on her

70. F. NO CHANGE  
G. poems, which varied in form, style, and line length.  
H. poems, most without obvious rhyme.  
J. poems.

71. Given that all the choices are true, which one would most clearly describe an interaction between Susan and Emily during Emily's writing process?

- A. NO CHANGE
- B. liked the poem tremendously.
- C. considered and thought about the poem.
- D. praised the poem but suggested revisions.

1



1

a result, Emily wrote two other versions of the second stanza.

72

Dickinson's last twenty years of letters—many over 1,500 words in length—reveals the breadth and depth of

73

one's connection to the world through a wide circle of

74

correspondents. Perhaps, this legacy of letters, explains what she meant when she said that her friends were her “estate.”

75

72. F. NO CHANGE  
G. rewrote two other alternate  
H. rewrote two additional alternate  
J. wrote two alternate revised

73. A. NO CHANGE  
B. reveal  
C. will of revealed  
D. would of revealed

74. F. NO CHANGE  
G. people's  
H. her  
J. their

75. A. NO CHANGE  
B. Perhaps this, legacy of letters,  
C. Perhaps this legacy of letters,  
D. Perhaps this legacy of letters

**END OF TEST 1**

**STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.**

2



2

**MATHEMATICS TEST***60 Minutes—60 Questions*

**DIRECTIONS:** Solve each problem, choose the correct answer, and then fill in the corresponding oval on your answer document.

Do not linger over problems that take too much time. Solve as many as you can; then return to the others in the time you have left for this test.

You are permitted to use a calculator on this test. You may use your calculator for any problems you choose,

but some of the problems may best be done without using a calculator.

Note: Unless otherwise stated, all of the following should be assumed.

1. Illustrative figures are NOT necessarily drawn to scale.
2. Geometric figures lie in a plane.
3. The word *line* indicates a straight line.
4. The word *average* indicates arithmetic mean.

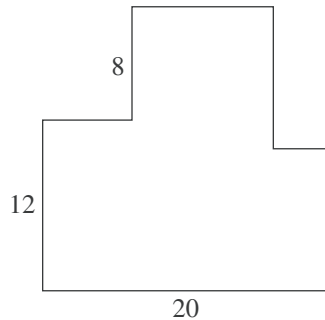
1. Two enterprising college students decide to start a business. They will make up and deliver helium balloon bouquets for special occasions. It will cost them \$39.99 to buy a machine to fill the balloons with helium. They estimate that it will cost them \$2.00 to buy the balloons, helium, and ribbons needed to make each balloon bouquet. Which of the following expressions could be used to model the total cost for producing  $b$  balloon bouquets?
  - A.  $\$ 2.00b + \$39.99$
  - B.  $\$37.99b$
  - C.  $\$39.99b + \$ 2.00$
  - D.  $\$41.99b$
  - E.  $\$79.98b$
2. What is the value of the expression  $(x - y)^2$  when  $x = 5$  and  $y = -1$  ?
  - F. 4
  - G. 6
  - H. 16
  - J. 24
  - K. 36
3. On the first day of school, Mr. Vilani gave his third-grade students 5 new words to spell. On each day of school after that, he gave the students 3 new words to spell. In the first 20 days of school, how many new words had he given the students to spell?
  - A. 28
  - B. 62
  - C. 65
  - D. 68
  - E. 152
4. Which of the following is equivalent to  $(4x^2)^3$  ?
  - F.  $64x^8$
  - G.  $64x^6$
  - H.  $12x^6$
  - J.  $12x^5$
  - K.  $4x^6$
5. Which of the following lists all the positive factors of 8 ?
  - A. 1, 8
  - B. 2, 4
  - C. 2, 4, 6
  - D. 8, 16, 32
  - E. 1, 2, 4, 8
6. Which of the following is an equivalent simplified expression for  $2(4x + 7) - 3(2x - 4)$  ?
  - F.  $x + 2$
  - G.  $2x + 2$
  - H.  $2x + 26$
  - J.  $3x + 10$
  - K.  $3x + 11$
7. To determine a student's overall test score for the semester, Ms. Lopez throws out the lowest test score and takes the average of the remaining test scores. Victor earned the following test scores in Ms. Lopez's class this semester: 62, 78, 83, 84, and 93. What overall test score did Victor earn in Ms. Lopez's class this semester?
  - A. 67.6
  - B. 80.0
  - C. 83.0
  - D. 83.5
  - E. 84.5
8. Uptown Cable, a cable TV provider, charges each customer \$120 for installation, plus \$25 per month for cable programming. Uptown's competitor, Downtown Cable, charges each customer \$60 for installation, plus \$35 per month for cable programming. A customer who signs up with Uptown will pay the same total amount for cable TV as a customer who signs up with Downtown if each pays for installation and cable programming for how many months?
  - F. 3
  - G. 6
  - H. 10
  - J. 18
  - K. 30

2



2

9. In the 8-sided figure below, adjacent sides meet at right angles and the lengths given are in meters. What is the perimeter of the figure, in meters?



- A. 40  
B. 80  
C. 120  
D. 160  
E. 400

10. The sum of the real numbers  $x$  and  $y$  is 11. Their difference is 5. What is the value of  $xy$ ?

- F. 3  
G. 5  
H. 8  
J. 24  
K. 55

11. For all  $x$ ,  $(3x + 7)^2 = ?$

- A.  $6x + 14$   
B.  $6x^2 + 14$   
C.  $9x^2 + 49$   
D.  $9x^2 + 21x + 49$   
E.  $9x^2 + 42x + 49$

12. What is the slope of the line through  $(-5, 2)$  and  $(6, 7)$  in the standard  $(x, y)$  coordinate plane?

- F. 9  
G. 5  
H. -5  
J.  $\frac{5}{11}$   
K.  $-\frac{5}{11}$

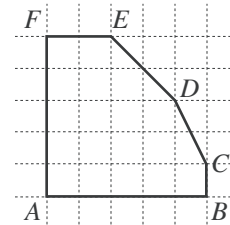
13. When  $\frac{1}{3}k + \frac{1}{4}k = 1$ , what is the value of  $k$ ?

- A.  $\frac{1}{7}$   
B.  $\frac{12}{7}$   
C.  $\frac{7}{2}$   
D. 6  
E. 12

14. What is the length, in feet, of the hypotenuse of a right triangle with legs that are 6 feet long and 7 feet long, respectively?

- F.  $\sqrt{13}$   
G.  $\sqrt{85}$   
H. 13  
J. 21  
K. 42

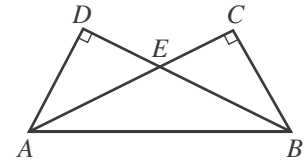
15. Hexagon  $ABCDEF$  shown below was drawn on a grid with unit squares. Each vertex is at the intersection of 2 grid lines. What is the area of the hexagon, in square units?



- A. 18  
B. 19  
C. 20  
D. 22  
E. 25

16. In the figure below,  $\overline{AD}$  is perpendicular to  $\overline{BD}$ ,  $\overline{AC}$  is perpendicular to  $\overline{BC}$ , and  $AD \cong BC$ . Which of the following congruences is NOT necessarily true?

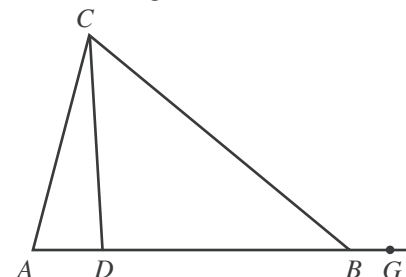
- F.  $\overline{AC} \cong \overline{BD}$   
G.  $\overline{AD} \cong \overline{AE}$   
H.  $\overline{AE} \cong \overline{BE}$   
J.  $\angle DAB \cong \angle CBA$   
K.  $\angle EAB \cong \angle EBA$



17. Leticia went into Discount Music to price CDs. All CDs were discounted 23% off the marked price. Leticia wanted to program her calculator so she could input the marked price and the discounted price would be the output. Which of the following is an expression for the discounted price on a marked price of  $p$  dollars?

- A.  $p - 0.23p$   
B.  $p - 0.23$   
C.  $p - 23p$   
D.  $p - 23$   
E.  $0.23p$

18. In the figure below,  $A$ ,  $D$ ,  $B$ , and  $G$  are collinear. If  $\angle CAD$  measures  $76^\circ$ ,  $\angle BCD$  measures  $47^\circ$ , and  $\angle CBG$  measures  $140^\circ$ , what is the degree measure of  $\angle ACD$ ?



- F.  $12^\circ$   
G.  $14^\circ$   
H.  $17^\circ$   
J.  $36^\circ$   
K.  $43^\circ$

2



2

19. Ms. Lewis plans to drive 900 miles to her vacation destination, driving an average of 50 miles per hour. How many miles per hour faster must she average, while driving, to reduce her total driving time by 3 hours?

A. 5  
B. 8  
C. 10  
D. 15  
E. 18

20. For all positive integers  $x$ , what is the greatest common factor of the 2 numbers  $216x$  and  $180x$ ?

F. 6  
G. 72  
H.  $x$   
J.  $12x$   
K.  $36x$

21. The table below shows the price of different quantities of standard-sized lemons at Joe's Fruit Stand. What is the least amount of money needed to purchase exactly 20 standard-sized lemons if the bags must be sold intact and there is no tax charged for lemons?

Number of lemons:	1	bag of 6	bag of 12
Total price:	\$0.30	\$1.20	\$2.10

A. \$3.60  
B. \$3.90  
C. \$4.20  
D. \$4.50  
E. \$6.00

22. The diameter,  $d$  centimeters, of the metal poles Goodpole Manufacturing produces must satisfy the inequality  $|d - 3| \leq 0.001$ . What is the maximum diameter, in centimeters, such a metal pole may have?

F. 1.4995  
G. 1.5005  
H. 2.999  
J. 3.000  
K. 3.001

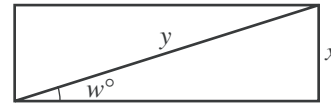
23. Which of the following is a factored form of the expression  $5x^2 - 13x - 6$ ?

A.  $(x - 3)(5x + 2)$   
B.  $(x - 2)(5x - 3)$   
C.  $(x - 2)(5x + 3)$   
D.  $(x + 2)(5x - 3)$   
E.  $(x + 3)(5x - 2)$

24. A bag contains 6 red marbles, 5 yellow marbles, and 7 green marbles. How many additional red marbles must be added to the 18 marbles already in the bag so that the probability of randomly drawing a red marble is  $\frac{3}{5}$ ?

F. 12  
G. 16  
H. 18  
J. 24  
K. 36

25. Which of the following trigonometric equations is valid for the side measurement  $x$  inches, diagonal measurement  $y$  inches, and angle measurement  $w^\circ$  in the rectangle shown below?

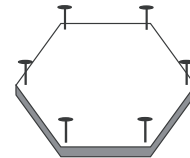


A.  $\cos w^\circ = \frac{x}{y}$   
B.  $\cot w^\circ = \frac{x}{y}$   
C.  $\sec w^\circ = \frac{x}{y}$   
D.  $\sin w^\circ = \frac{x}{y}$   
E.  $\tan w^\circ = \frac{x}{y}$

26. The slope of the line with equation  $y = ax + b$  is greater than the slope of the line with equation  $y = cx + b$ . Which of the following statements *must* be true about the relationship between  $a$  and  $c$ ?

F.  $a \leq c$   
G.  $a < c$   
H.  $a = c$   
J.  $a > c$   
K.  $a \geq c + 1$

27. Minh cuts a board in the shape of a regular hexagon and pounds in a nail at an equal distance from each vertex, as shown in the figure below. How many rubber bands will she need in order to stretch a different rubber band across every possible pair of nails?



A. 15  
B. 14  
C. 12  
D. 9  
E. 6

28. There are 280 runners registered for a race, and the runners are divided into 4 age categories, as shown in the table below.

Age category:	under 16	16–25	26–35	over 35
Number of runners:	40	76	112	52

The prize committee has 60 prizes to award and wants the prizes to be awarded in proportion to the number of runners registered in each category. How many prizes should be designated for the 26–35 age category?

F. 15  
G. 17  
H. 24  
J. 36  
K. 40

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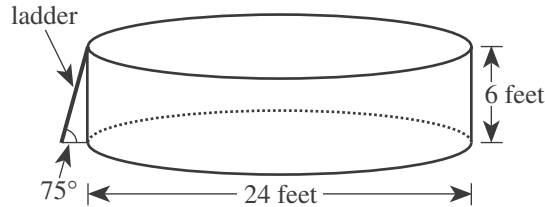
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2

Use the following information to answer questions 29–32.

The youth center has installed a swimming pool on level ground. The pool is a right circular cylinder with a diameter of 24 feet and a height of 6 feet. A diagram of the pool and its entry ladder is shown below.

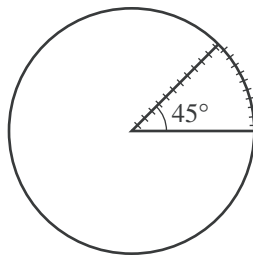


29. To the nearest cubic foot, what is the volume of water that will be in the pool when it is filled with water to a depth of 5 feet?

(Note: The volume of a cylinder is given by  $\pi r^2 h$ , where  $r$  is the radius and  $h$  is the height.)

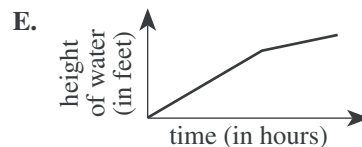
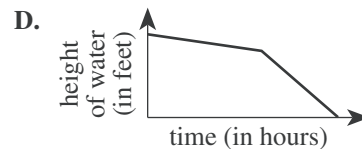
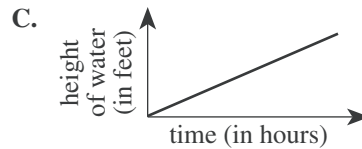
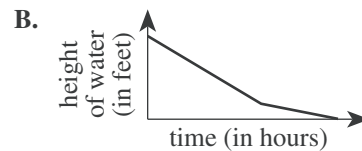
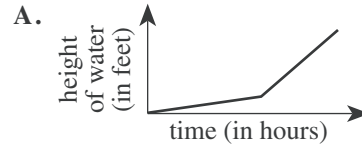
- A. 942
- B. 1,885
- C. 2,262
- D. 9,047
- E. 11,310

30. A plastic cover is made for the pool. The cover will rest on the top of the pool and will include a wedge-shaped flap that forms a  $45^\circ$  angle at the center of the cover, as shown in the figure below. A zipper will go along 1 side of the wedge-shaped flap and around the arc. Which of the following is closest to the length, in feet, of the zipper?



- F. 17
- G. 22
- H. 24
- J. 29
- K. 57

31. Two hoses are used to fill the pool. Twice as many gallons of water per minute flow through one of the hoses as through the other. Both hoses had been on for 12 hours and had filled the pool to the 4-foot mark when the hose with the faster flow stopped working. The hose with the slower flow then finished filling the pool to the 5-foot mark. Which of the following graphs shows the relationship between the time spent filling the pool and the height of the water in the pool?



32. The directions for assembling the pool state that the ladder should be placed at an angle of  $75^\circ$  relative to level ground. Which of the following expressions involving tangent gives the distance, in feet, that the bottom of the ladder should be placed away from the bottom edge of the pool in order to comply with the directions?

F.  $\frac{6}{\tan 75^\circ}$

G.  $\frac{\tan 75^\circ}{6}$

H.  $\frac{1}{6 \tan 75^\circ}$

J.  $6 \tan 75^\circ$

K.  $\tan(6 \cdot 75^\circ)$



2



2

33. For a population that grows at a constant rate of  $r\%$  per year, the formula  $P(t) = p_o \left(1 + \frac{r}{100}\right)^t$  models the population  $t$  years after an initial population of  $p_o$  people is counted.

The population of the city of San Jose was 782,000 in 1990. Assume the population grows at a constant rate of 5% per year. According to this formula, which of the following is an expression for the population of San Jose in the year 2000?

- A.  $782,000(6)^{10}$
- B.  $782,000(1.5)^{10}$
- C.  $782,000(1.05)^{10}$
- D.  $(782,000 \times 1.5)^{10}$
- E.  $(782,000 \times 1.05)^{10}$

34. Tom's long-distance service charges \$0.10 per minute from 7:00 P.M. to 7:00 A.M. on weekdays, all day on Saturdays, and all day on holidays; \$0.05 per minute all day on Sundays; and \$0.25 per minute at all other times. The table below gives his long-distance calls for 1 week, including the date and day of each call, the time it was placed, and the number of minutes it lasted.

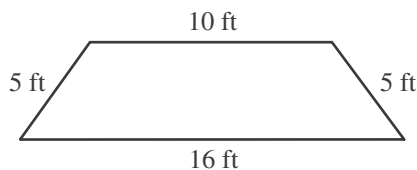
Date and day	Time	Number of minutes
11/22 Tuesday	5:00 P.M.	8
11/23 Wednesday	10:30 A.M.	10
11/24 Thursday Thanksgiving holiday	11:30 A.M.	15
11/26 Saturday	9:30 A.M.	17
11/27 Sunday	12:15 P.M.	22

What did Tom's long-distance service charge him for the calls in the table?

- F. \$7.30
- G. \$7.60
- H. \$7.95
- J. \$8.80
- K. \$9.90

35. The parallel sides of the isosceles trapezoid shown below are 10 feet long and 16 feet long, respectively. What is the distance, in feet, between these 2 sides?

- A. 3
- B. 4
- C. 5
- D. 10
- E. 16



36. The inequality  $3(x + 2) > 4(x - 3)$  is equivalent to which of the following inequalities?

- F.  $x < -6$
- G.  $x < 5$
- H.  $x < 9$
- J.  $x < 14$
- K.  $x < 18$

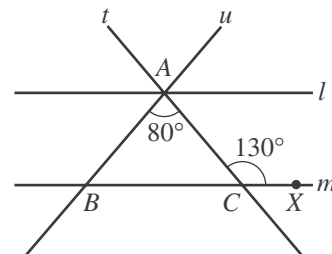
37. In the standard  $(x,y)$  coordinate plane, the midpoint of  $\overline{AB}$  is  $(4,-3)$  and  $A$  is located at  $(1,-5)$ . If  $(x,y)$  are the coordinates of  $B$ , what is the value of  $x + y$ ?

- A. 19
- B. 8
- C. 6
- D.  $-1.5$
- E.  $-3$

38. For all  $x$  in the domain of the function  $\frac{x+1}{x^3-x}$ , this function is equivalent to:

- F.  $\frac{1}{x^2} - \frac{1}{x^3}$
- G.  $\frac{1}{x^3} - \frac{1}{x}$
- H.  $\frac{1}{x^2 - 1}$
- J.  $\frac{1}{x^2 - x}$
- K.  $\frac{1}{x^3}$

39. In the figure below, line  $l$  is parallel to line  $m$ . Transversals  $t$  and  $u$  intersect at point  $A$  on  $l$  and intersect  $m$  at points  $C$  and  $B$ , respectively. Point  $X$  is on  $m$ , the measure of  $\angle ACX$  is  $130^\circ$ , and the measure of  $\angle BAC$  is  $80^\circ$ . How many of the angles formed by rays of  $l$ ,  $m$ ,  $t$ , and  $u$  have measure  $50^\circ$ ?



- A. 4
- B. 6
- C. 8
- D. 10
- E. 12

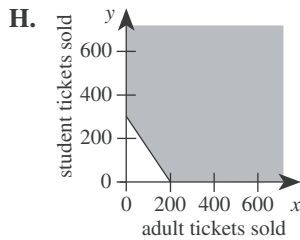
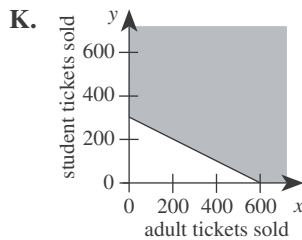
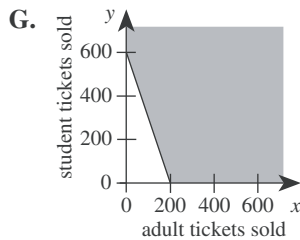
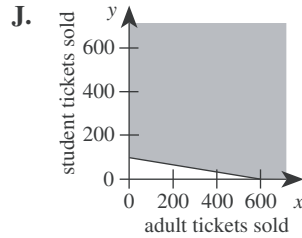
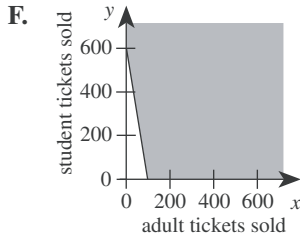
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2



2

40. Tickets for the Senior Talent Show at George Washington Carver High School are \$3 for adults and \$2 for students. To cover expenses, a total of \$600 must be collected from ticket sales for the show. One of the following graphs in the standard  $(x,y)$  coordinate plane, where  $x$  is the number of adult tickets sold and  $y$  is the number of student tickets sold, represents all the possible combinations of ticket sales that cover at least \$600 in expenses. Which graph is it?



41. What is the median of the following 7 scores?

42, 67, 33, 79, 33, 89, 21

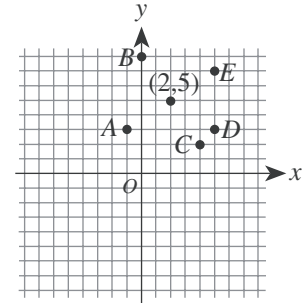
- A. 42  
B. 52  
C. 54.5  
D. 56  
E. 79

42. What are the real solutions to the equation  $|x|^2 + 2|x| - 3 = 0$ ?

- F.  $\pm 1$   
G.  $\pm 3$   
H. 1 and 3  
J. -1 and -3  
K.  $\pm 1$  and  $\pm 3$

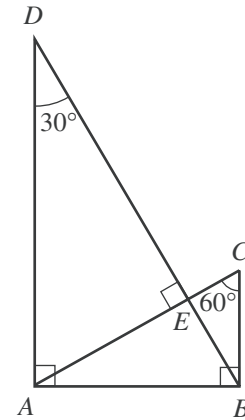
43. The point  $(2,5)$  is shown in the standard  $(x,y)$  coordinate plane below. Which of the following is another point on the line through the point  $(2,5)$  with a slope of  $-\frac{2}{3}$ ?

- A.  $A(-1,3)$   
B.  $B(0,8)$   
C.  $C(4,2)$   
D.  $D(5,3)$   
E.  $E(5,7)$

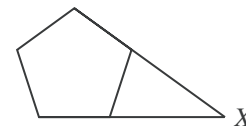


44. For the triangles in the figure below, which of the following ratios of side lengths is equivalent to the ratio of the perimeter of  $\triangle ABC$  to the perimeter of  $\triangle DAB$ ?

- F.  $AB:AD$   
G.  $AB:BD$   
H.  $AD:BD$   
J.  $BC:AD$   
K.  $BC:BD$



45. In the figure below, 2 nonadjacent sides of a regular pentagon (5 congruent sides and 5 congruent interior angles) are extended until they meet at point X. What is the measure of  $\angle X$ ?



- A.  $18^\circ$   
B.  $30^\circ$   
C.  $36^\circ$   
D.  $45^\circ$   
E.  $72^\circ$

46. The edges of a cube are each 3 inches long. What is the surface area, in square inches, of this cube?

- F. 9  
G. 18  
H. 27  
J. 36  
K. 54

2



2

47. A number is increased by 25% and the resulting number is then decreased by 20%. The final number is what percent of the original number?

A. 90%  
B. 95%  
C. 100%  
D. 105%  
E. 120%

48. Two numbers are *reciprocals* if their product is equal to 1. If  $x$  and  $y$  are reciprocals and  $x > 1$ , then  $y$  must be:

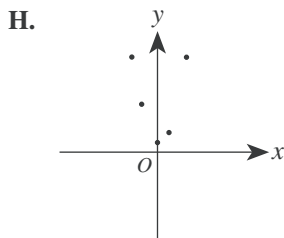
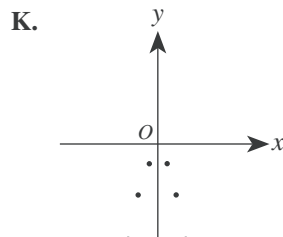
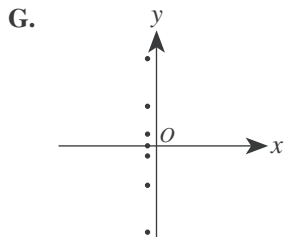
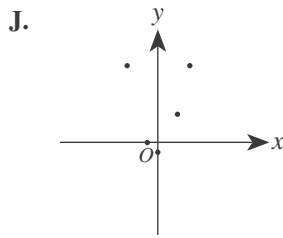
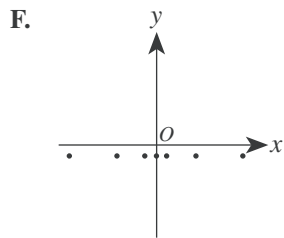
F. less than  $-1$ .  
G. between 0 and  $-1$ .  
H. equal to 0.  
J. between 0 and 1.  
K. greater than 1.

49. The number line graph below is the graph of which of the following inequalities?



A.  $-1 \leq x$  and  $3 \leq x$   
B.  $-1 \leq x$  and  $3 \geq x$   
C.  $-1 \leq x$  or  $3 \leq x$   
D.  $-1 \geq x$  or  $3 \leq x$   
E.  $-1 \geq x$  or  $3 \geq x$

50. All of the following graphs have equal scales on the axes. One of the graphs shows only points for which the  $y$ -coordinate is 1 less than the square of the  $x$ -coordinate. Which one?



51. In teaching a lesson on the concept of thirds, Ms. Chu uses a divide-and-set-aside procedure. She starts with a certain number of colored disks, divides them into 3 equal groups, and sets 1 group aside to illustrate  $\frac{1}{3}$ . She repeats the procedure by taking the disks she had NOT set aside, dividing them into 3 equal groups, and setting 1 of these groups aside. If Ms. Chu wants to be able to complete the divide-and-set-aside procedure at least 4 times (without breaking any of the disks into pieces), which of the following is the minimum number of colored disks she can start with?

A. 12  
B. 15  
C. 27  
D. 54  
E. 81

52. Which of the following is true for all consecutive integers  $m$  and  $n$  such that  $m < n$ ?

F.  $m$  is odd  
G.  $n$  is odd  
H.  $n - m$  is even  
J.  $n^2 - m^2$  is odd  
K.  $m^2 + n^2$  is even

53. A function  $P$  is defined as follows:

$$\begin{aligned} \text{for } x > 0, P(x) &= x^5 + x^4 - 36x - 36 \\ \text{for } x < 0, P(x) &= -x^5 + x^4 + 36x - 36 \end{aligned}$$

What is the value of  $P(-1)$ ?

A.  $-70$   
B.  $-36$   
C.  $0$   
D.  $36$   
E.  $70$

54. For a project in Home Economics class, Kirk is making a tablecloth for a circular table 3 feet in diameter. The finished tablecloth needs to hang down 5 inches over the edge of the table all the way around. To finish the edge of the tablecloth, Kirk will fold under and sew down 1 inch of the material all around the edge. Kirk is going to use a single piece of rectangular fabric that is 60 inches wide. What is the shortest length of fabric, in inches, Kirk could use to make the tablecloth without putting any separate pieces of fabric together?

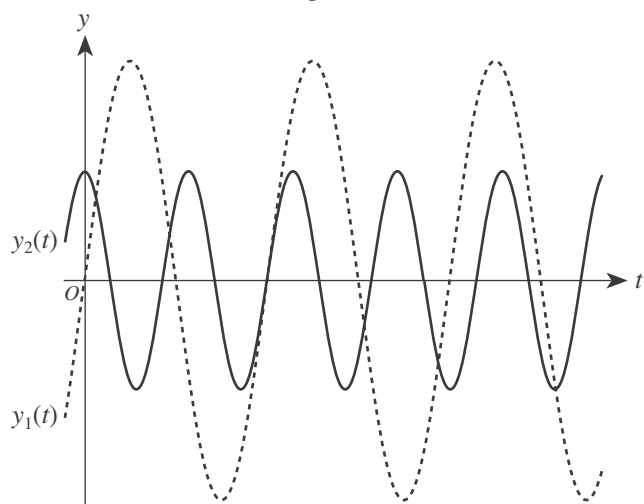
F. 15  
G. 24  
H. 30  
J. 42  
K. 48

2



2

55. The equations of the 2 graphs shown below are  $y_1(t) = a_1 \sin(b_1 t)$  and  $y_2(t) = a_2 \cos(b_2 t)$ , where the constants  $b_1$  and  $b_2$  are both positive real numbers.



Which of the following statements is true of the constants  $a_1$  and  $a_2$ ?

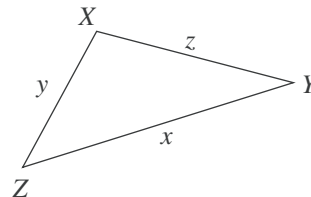
- A.  $0 < a_1 < a_2$   
 B.  $0 < a_2 < a_1$   
 C.  $a_1 < 0 < a_2$   
 D.  $a_1 < a_2 < 0$   
 E.  $a_2 < a_1 < 0$
56. For  $x$  such that  $0 < x < \frac{\pi}{2}$ , the expression

$$\frac{\sqrt{1 - \cos^2 x}}{\sin x} + \frac{\sqrt{1 - \sin^2 x}}{\cos x}$$

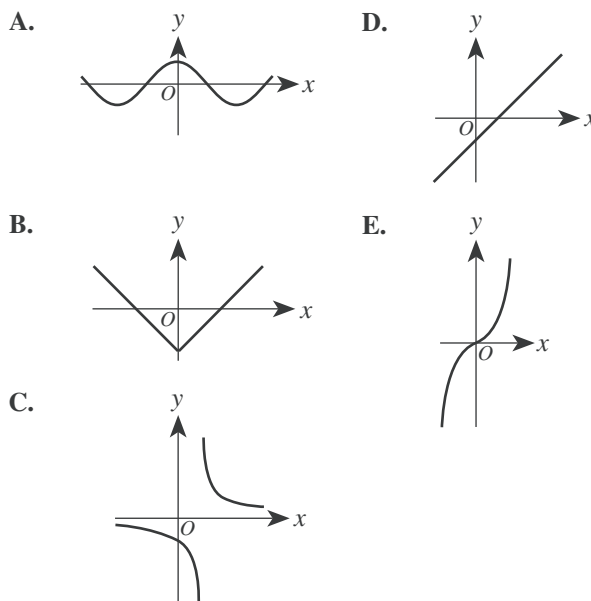
is equivalent to:

- F. 0  
 G. 1  
 H. 2  
 J.  $-\tan x$   
 K.  $\sin 2x$
57. Consider the functions  $f(x) = \sqrt{x}$  and  $g(x) = 7x + b$ . In the standard  $(x,y)$  coordinate plane,  $y = f(g(x))$  passes through  $(4,6)$ . What is the value of  $b$ ?
- A. 8  
 B. -8  
 C. -25  
 D. -26  
 E.  $4 - 7\sqrt{6}$

58. The triangle,  $\triangle XYZ$ , that is shown below has side lengths of  $x$ ,  $y$ , and  $z$  inches and is not a right triangle. Let  $X'$  be the image of  $X$  when the triangle is reflected across  $\overline{YZ}$ . Which of the following is an expression for the perimeter, in inches, of quadrilateral  $X'YXZ$ ?



- F.  $2(y + z) + x$   
 G.  $2(x + y + z)$   
 H.  $2(x + y)$   
 J.  $2(x + z)$   
 K.  $2(y + z)$
59. A function  $f$  is an *odd* function if and only if  $f(-x) = -f(x)$  for every value of  $x$  in the domain of  $f$ . One of the functions graphed in the standard  $(x,y)$  coordinate plane below is an odd function. Which one?



60. What is the real value of  $x$  in the equation  $\log_2 24 - \log_2 3 = \log_5 x$ ?
- F. 3  
 G. 21  
 H. 72  
 J. 125  
 K. 243

END OF TEST 2

STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.

DO NOT RETURN TO THE PREVIOUS TEST.

## READING TEST

35 Minutes—40 Questions

**DIRECTIONS:** There are four passages in this test. Each passage is followed by several questions. After reading a passage, choose the best answer to each question and fill in the corresponding oval on your answer document. You may refer to the passages as often as necessary.

## Passage I

**PROSE FICTION:** This passage is adapted from the short story “American History” by Judith Ortiz-Cofer (©1992 by Judith Ortiz-Cofer). The story appeared in the anthology *Iguana Dreams: New Latino Fiction*.

There was only one source of beauty and light for me my ninth grade year. The only thing I had anticipated at the start of the semester. That was seeing Eugene. In August, Eugene and his family had moved  
5 into the only house on the block that had a yard and trees. I could see his place from my bedroom window in El Building. In fact, if I sat on the fire escape I was literally suspended above Eugene’s backyard. It was my favorite spot to read my library books in the summer.  
10 Until that August the house had been occupied by an old couple. Over the years I had become part of their family, without their knowing it, of course. I had a view of their kitchen and their backyard, and though I could not hear what they said, I knew when they were arguing,  
15 when one of them was sick, and many other things. I knew all this by watching them at mealtimes. I could see their kitchen table, the sink, and the stove. During good times, he sat at the table and read his newspapers while she fixed the meals. If they argued, he would leave and  
20 the old woman would sit and stare at nothing for a long time. When one of them was sick, the other would come and get things from the kitchen and carry them out on a tray. The old man had died in June. The house had stood empty for weeks. I had had to resist the temptation to  
25 climb down into the yard and water the flowers the old lady had taken such good care of.

By the time Eugene’s family moved in, the yard was a tangled mass of weeds. The father had spent several days mowing, and when he finished, from where I  
30 sat, I didn’t see the red, yellow, and purple clusters that meant flowers to me. I didn’t see this family sit down at the kitchen table together. It was just the mother, a red-headed tall woman who wore a white uniform; the father was gone before I got up in the morning and was  
35 never there at dinner time. I only saw him on weekends when they sometimes sat on lawn-chairs under the oak tree, each hidden behind a section of the newspaper; and there was Eugene. He was tall and blond, and he wore glasses. I liked him right away because he sat at  
40 the kitchen table and read books for hours. That summer, before we had even spoken one word to each other, I kept him company on my fire escape.

Once school started I looked for him in all my classes, but P. S. 13 was a huge place and it took me  
45 days and many discreet questions to discover Eugene. After much maneuvering I managed “to run into him” in the hallway where his locker was—on the other side of the building from mine—and in study hall at the library where he first seemed to notice me, but did not  
50 speak; and finally, on the way home after school one day when I decided to approach him directly, though my stomach was doing somersaults.

I was ready for rejection, snobbery, the worst. But when I came up to him and blurted out: “You’re  
55 Eugene. Right?” he smiled, pushed his glasses up on his nose, and nodded. I saw then that he was blushing deeply. Eugene liked me, but he was shy. I did most of the talking that day. He nodded and smiled a lot. In the weeks that followed, we walked home together. He  
60 would linger at the corner of El Building for a few minutes then walk down to his house.

I did not tell Eugene that I could see inside his kitchen from my bedroom. I felt dishonest, but I liked my secret sharing of his evenings, especially now that I  
65 knew what he was reading since we chose our books together at the school library.

I also knew my mother was unhappy in Paterson, New Jersey, but my father had a good job at the blue-jeans factory in Passaic and soon, he kept assuring us,  
70 we would be moving to our own house there. I had learned to listen to my parents’ dreams, which were spoken in Spanish, as fairy tales, like the stories about life in Puerto Rico before I was born. I had been to the island once as a little girl. We had not been back there  
75 since then, though my parents talked constantly about buying a house on the beach someday, retiring on the island—that was a common topic among the residents of El Building. As for me, I was going to go to college and become a teacher.

But after meeting Eugene I began to think of the present more than of the future. What I wanted now was to enter that house I had watched for so many years. I wanted to see the other rooms where the old people had lived, and where the boy spent his time. Most of all, I  
85 wanted to sit at the kitchen table with Eugene like two adults, like the old man and his wife had done, maybe drink some coffee and talk about books.

GO ON TO THE NEXT PAGE.

3

3

1. The main theme of this passage concerns the:
  - A. difficulty of first starting and then maintaining a friendship.
  - B. process of making a new friend and how the friendship changes the narrator.
  - C. problems the narrator has dealing with the loss of her former neighbors.
  - D. differences in the lives led by two pairs of adults who at different times lived in the same house.
2. Which of the following questions is NOT answered by information in the passage?
  - F. Has the narrator ever walked around inside Eugene's house?
  - G. What hobby or interest do Eugene and the narrator share?
  - H. What makes Eugene's house different from other houses on the block?
  - J. What careers other than teaching has the narrator considered pursuing?
3. The narrator draws which of the following comparisons between the old couple and Eugene's parents?
  - A. The old couple were more socially outgoing and had many more friends than Eugene's parents.
  - B. Eugene's parents are just as interested in tending the lawn and flowers as the old couple were.
  - C. Eugene's parents are less nurturing of each other and spend less time together than the old couple did.
  - D. Just like the old man and old woman, both of Eugene's parents appear to have jobs outside the home.
4. In terms of developing the narrative, the last two paragraphs (lines 67–87) primarily serve to:
  - F. provide background details about the narrator and her family in order to highlight the narrator's unique and shifting perspective.
  - G. describe the narrator's family in order to establish a contrast between her parents and Eugene's parents.
  - H. portray the narrator's family in order to show how her friendship with Eugene affected the various members of her family.
  - J. depict the hopes and dreams of the narrator's parents in order to show how her parents' aspirations changed over time.
5. It can most reasonably be inferred from the passage that when the narrator says, "I didn't see the red, yellow, and purple clusters that meant flowers to me" (lines 30–31), she is most nearly indicating that:
  - A. from her current position, she couldn't see the old woman's flowers, which were still growing near the house.
  - B. the flowers grown by the old woman had died because the narrator had stopped watering them.
  - C. the flowers grown by the old woman had been cut down when Eugene's father mowed the lawn.
  - D. the weeds that had grown up in the old couple's lawn had intertwined with the flowers, making the flowers hard to see.
6. According to the narrator, which of the following statements was true about Eugene at the moment when she first talked to him?
  - F. Due to the size of the school, he had not even noticed the narrator until she started talking to him.
  - G. He had searched unsuccessfully for the narrator's locker several different times and had been too shy to ask someone where it was.
  - H. He had first noticed the narrator in study hall but had been uninterested in her until she introduced herself.
  - J. He had apparently taken notice of the narrator at school and had come to like her but felt nervous about introducing himself.
7. When the narrator says, "I began to think of the present more than of the future" (lines 80–81), she most likely means that meeting Eugene led her to:
  - A. shift some of her attention away from her career plans and onto the developing friendship.
  - B. think more about her own work interests than about the career her parents thought she should pursue.
  - C. put off her plans of returning to Puerto Rico for a visit in favor of continuing to prepare for college.
  - D. want to spend more time with him instead of helping her parents plan a vacation to Puerto Rico.
8. The narrator most nearly portrays her parents' dreams as:
  - F. close to being realized because of her father's good job.
  - G. somewhat uncommon among the other residents of the family's building.
  - H. ones she has heard about many times but that seem far off and remote to her.
  - J. ones she shares with her parents and longs to fulfill.
9. The narrator claims that she felt close to the old couple because she had:
  - A. listened in on so many of their conversations over the years.
  - B. helped take care of the old woman's flowers after the woman's husband had died.
  - C. been able to watch them as they moved through their entire house.
  - D. regularly observed them during their mealtimes.
10. Which of the following best describes the narrator's feelings about secretly observing Eugene at his home?
  - F. Joy tinged with suspicion
  - G. Enjoyment mixed with guilt
  - H. Happiness overwhelmed by a sense of betrayal
  - J. Pleasure lessened by having actually met him



3

3

## Passage II

**SOCIAL SCIENCE:** This passage is adapted from volume 2 of Blanche Wiesen Cook's biography *Eleanor Roosevelt* (©1999 by Blanche Wiesen Cook).

Eleanor Roosevelt [ER] is the most controversial First Lady in United States history. Her journey to greatness, her voyage out beyond the confines of good wife and devoted mother, involved determination and  
5 amazing courage. It also involved one of history's most unique partnerships. Franklin Delano Roosevelt [FDR] admired his wife, appreciated her strengths, and depended on her integrity.

However, ER and FDR had different priorities, occasionally competing goals, and often disagreed. In  
10 the White House they ran two distinct and separate courts.

By 1933 [her first year as First Lady], ER was an accomplished woman who had achieved several of her  
15 life's goals. With her partners, ER was a businesswoman who co-owned the Val-Kill crafts factory, a political leader who edited and copublished the *Women's Democratic News*, and an educator who co-owned and taught at a New York school for girls.

As First Lady, Eleanor Roosevelt did things that had never been done before. She upset race traditions, championed a New Deal for women, and on certain  
20 issues actually ran a parallel administration. On housing and the creation of model communities, for example, ER made decisions and engineered policy.

At the center of a network of influential women who ran the Women's Committee of the Democratic Party led by Molly Dewson, ER worked closely with the women who had dominated the nation's social  
30 reform struggles for decades. With FDR's election, the goals of the great progressive pioneers, Jane Addams, Florence Kelley, and Lillian Wald, were at last at the forefront of the country's agenda. ER's mentors since 1903, they had battled on the margins of national politics since the 1880s for public health, universal education, community centers, sanitation programs, and  
35 government responsibility for the welfare of the nation's poor and neglected people.

Now their views were brought directly into the White House. ER lobbied for them personally with her  
40 new administrative allies, in countless auditoriums, as a radio broadcaster, and in monthly, weekly, and, by 1936, daily columns. Called "Eleanor Everywhere," she was interested in everyone.

Every life was sacred and worthy, to be improved by education, employment, health care, and affordable housing. Her goal was simple, a life of dignity and  
45 decency for all. She was uninterested in complex theories, and demanded action for betterment. She feared violent revolution, but was not afraid of socialism—and she courted radicals.

As fascism and communism triumphed in Europe and Asia, ER and FDR were certain that there was a middle way, what ER called an American "revolution  
55 without bloodshed." Her abiding conviction, however, was that nothing good would happen to promote the people's interest unless the people themselves organized to demand government responses. A people's movement required active citizen participation, and  
60 ER's self-appointed task was to agitate and inspire community action, encourage united democratic movements for change.

Between 1933 and 1938, while the Depression raged and the New Deal unfolded, ER worked with the  
65 popular front. She called for alliances of activists to fight poverty and racism at home, and to oppose isolationism internationally.

Active with the women's peace movement, ER spoke regularly at meetings of the Women's International League for Peace and Freedom, and the Conference on the Cause and Cure of War. She departed,  
70 however, from pacifist and isolationist positions and encouraged military preparedness, collective security, and ever-widening alliances.

Between 1933 and 1938 ER published countless articles and six books. She wrote in part for herself, to clear her mind and focus her thoughts. But she also wrote to disagree with her husband. From that time to  
75 this, no other First Lady has actually rushed for her pen to jab her husband's public decisions. But ER did so routinely, including in her 1938 essay *This Troubled World*, which was a point-by-point rejection of FDR's major international decisions.

To contemplate ER's life of example and responsibility is to forestall gloom. She understood, above all,  
85 that politics is not an isolated individualist adventure. She sought alliances, created community, worked with movements for justice and peace. Against great odds, and under terrific pressure, she refused to withdraw from controversy. She brought her network of agitators and activists into the White House, and never considered a political setback a permanent defeat. She  
90 enjoyed the game, and weathered the abuse.

11. As she is revealed in the passage, ER is best described as:
- A. socially controversial but quietly cooperative.
  - B. politically courageous and socially concerned.
  - C. morally strong and deeply traditional.
  - D. personally driven but calmly moderate.

3

3

12. The author presents ER's accomplishments as exceptional because ER:
- F. brought politically unpopular views to the forefront of the nation's politics.
  - G. was the first public figure to introduce political roles for women.
  - H. was a political pioneer struggling alone for social reform.
  - J. replaced community action with more powerful White House networks.
13. According to the passage, ER believed that social reform should include all of the following EXCEPT:
- A. promoting community action.
  - B. developing universal education.
  - C. supporting affordable housing.
  - D. establishing involved theories.
14. Based on the passage, ER's approach to social reform can best be characterized as:
- F. passionate and theoretical.
  - G. patient and flexible.
  - H. simplistic and isolationist.
  - J. progressive and determined.
15. It can reasonably be inferred from the passage that at the time ER began working for social reform, the United States was:
- A. deeply committed to reforms in education and health care.
  - B. experiencing a time of national prosperity that contributed to ER's ideals concerning the public welfare.
  - C. concentrating on affairs at home due to isolationist policies and the spread of democracy overseas.
  - D. unsupportive of the idea that the government was responsible for the welfare of its poor and neglected.
16. According to the last paragraph, which of the following statements would the author most likely make with regard to ER's vision and ideals?
- F. ER considered politics a game and played only when she knew she could win.
  - G. ER worked with agitators and remained dedicated to the pursuit of justice and peace in victory and defeat.
  - H. ER placed herself in the position of president, making decisions that determined White House policy.
  - J. ER saw herself as the country's role model and personally responsible for bringing about change.
17. In terms of the passage as a whole, one of the main functions of the third paragraph (lines 13–19) is to suggest that:
- A. ER's successes in various professional pursuits helped prepare her to take action in the political world.
  - B. ER had avoided the political spotlight in her personal pursuits.
  - C. ER had competing and conflicting interests during her first year as first lady.
  - D. while ER had many personal accomplishments, little could have prepared her for life as the first lady.
18. According to the passage, the primary principle underlying ER's goals was that:
- F. every person deserved a dignified and decent life.
  - G. as first lady, she could talk about things that had never been discussed before.
  - H. through radio and columns, she could show she was interested in every person.
  - J. she must lead a bloodless American revolution.
19. The passage states that ER believed the relationship between a people and their government should be:
- A. begun and carried out as if it were an isolated, individualist adventure.
  - B. formed and modeled by the White House.
  - C. based on organized, widespread citizen participation.
  - D. controlled through radio broadcasts and formal channels.
20. In the context of the passage, the author's statement that ER "enjoyed the game, and weathered the abuse" (line 93) most nearly means that ER:
- F. enjoyed her individualist adventure in politics even if criticized.
  - G. preferred to be a team player rather than take the lead.
  - H. embraced the political life and accepted criticism as part of her work.
  - J. understood political games and so did not take politics or criticism very seriously.



## Passage III

**HUMANITIES:** This passage is adapted from the essay “The Interior Life” by Annie Dillard, which appeared in her book *An American Childhood* (©1987 by Annie Dillard).

The interior life is often stupid. Its egoism blinds it and deafens it; its imagination spins out ignorant tales, fascinated. It fancies that the western wind blows on the Self, and leaves fall at the feet of the Self for a reason, and people are watching. A mind risks real ignorance for the sometimes paltry prize of an imagination enriched. The trick of reason is to get the imagination to seize the actual world—if only from time to time.

When I was five, I would not go to bed willingly because something came into my room. My sister Amy, two years old, was asleep in the other bed. What did she know? She was innocent of evil. There was no messiness in her, no roughness for things to cling to, only a charming and charmed innocence that seemed then to protect her, an innocence I needed but couldn’t muster. Since Amy was asleep, furthermore, and since when I needed someone most I was afraid to stir enough to wake her, she was useless.

I lay alone and was almost asleep when the thing entered the room by flattening itself against the open door and sliding in. It was a transparent, luminous oblong. I could see the door whiten at its touch; I could see the blue wall turn pale where it raced over it, and see the maple headboard of Amy’s bed glow. It was a swift spirit; it was an awareness. It made noise. It had two joined parts, a head and a tail. It found the door, wall, and headboard; and it swiped them, charging them with its luminous glance. After its fleet, searching passage, things looked the same, but weren’t.

I dared not blink or breathe. If it found another awareness, it would destroy it.

Every night before it got to me it gave up. It hit my wall’s corner and couldn’t get past. It shrank completely into itself and vanished. I heard the rising roar it made when it died or left. I still couldn’t breathe. I knew that it could return again alive that same night.

Sometimes it came back, sometimes it didn’t. Most often, restless, it came back. The light stripe slipped in the door, ran searching over Amy’s wall, stopped, stretched lunatic at the first corner, raced wailing toward my wall, and vanished into the second corner with a cry. So I wouldn’t go to bed.

It was a passing car whose windshield reflected the corner streetlight outside. I figured it out one night.

Figuring it out was as memorable as the oblong itself. Figuring it out was a long and forced ascent to the very rim of being, to the membrane of skin that both separates and connects the inner life and the outer world. I climbed deliberately from the depths like a diver who releases the monster in his arms and hauls

himself hand over hand up an anchor chain till he meets the ocean’s sparkling membrane and bursts through it; he sights the sunlit, becalmed hull of his boat, which had bulked so ominously from below.

I recognized the noise it made when it left. That is, the noise it made called to mind, at last, my daytime sensations when a car passed—the sight and noise together. A car came roaring down hushed Edgerton Avenue in front of our house, stopped, and passed on shrieking as its engine shifted up the gears. What, precisely, came into the bedroom? A reflection from the car’s oblong windshield. Why did it travel in two parts? The window sash split the light and cast a shadow.

Night after night I labored up the same long chain of reasoning, as night after night the thing burst into the room where I lay awake.

There was a world outside my window and contiguous to it. Why did I have to keep learning this same thing over and over? For I had learned it a summer ago, when men with jackhammers broke up Edgerton Avenue. I had watched them from the yard. When I lay to nap, I listened. One restless afternoon I connected the new noise in my bedroom with the jackhammer men I had been seeing outside. I understood abruptly that these worlds met, the outside and the inside. “Outside,” then, was conceivably just beyond my windows.

The world did not have me in mind. It was a coincidental collection of things and people, of items, and I myself was one such item—a child walking up the sidewalk, whom anyone could see or ignore. The things in the world did not necessarily cause my overwhelming feelings; the feelings were inside me, beneath my skin, behind my ribs, within my skull. They were even, to some extent, under my control.

I could be connected to the outer world by reason, if I chose, or I could yield to what amounted to a narrative fiction, to a show in light projected on the room’s blue walls.

21. Which of the following statements best describes the structure of this passage?

- A. It begins and ends with a series of assertions that surround a story used by the narrator to support and elaborate on those assertions.
- B. It contains a highly detailed anecdote that the narrator uses to show how the claims she makes in the first paragraph are wrong.
- C. It compares and contrasts the narrator’s perspective on an incident in her life with the perspectives of several other people, such as her parents.
- D. It consists mainly of a story about a recent event in the narrator’s life that she feels taught her an interesting but ultimately insignificant lesson.

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22. In terms of mood, which of the following best describes lines 9–44?
- F. A steadily increasing feeling of tension
  - G. A consistently high level of tension
  - H. A growing feeling of tension that is finally broken
  - J. A feeling of tension frequently undermined by the narrator’s use of irony and humor
23. The narrator develops the third paragraph (lines 19–29) mainly through:
- A. detached philosophical musings on the nature of the object she sees.
  - B. a detailed description of what she did to try to keep the object out of her room.
  - C. sensory details vividly depicting the object and its movements.
  - D. imaginative speculation on what might be causing the object to appear.
24. The narrator indicates that one reason she did not wake her sister Amy when “something” came into their room was because:
- F. Amy had previously asked the narrator to stop waking her up during the night.
  - G. the narrator knew she could muster her own charmed innocence.
  - H. Amy had already figured out what the thing was before going to sleep.
  - J. the narrator was afraid of alerting the thing to her own presence.
25. It can reasonably be inferred from the passage that the narrator regards her initial discovery of the truth about the object entering her bedroom as:
- A. deflating, because the object turned out to be so ordinary.
  - B. disappointing, because she felt she should have solved the mystery many years ago.
  - C. satisfying, because she could at last ignore the object and go to sleep.
  - D. significant, because solving the mystery led to important insights.
26. It can most reasonably be inferred that for the narrator, the image of the diver bursting through “the ocean’s sparkling membrane” (line 52) symbolizes her:
- F. fear of monsters and of the object in her bedroom.
  - G. crossing of the boundary separating her inner and outer lives.
  - H. struggle to maintain the separation between her inner and outer worlds.
  - J. bitterness at entering reality and leaving behind her comforting memories.
27. As it is used in line 87, the phrase “a show in light” most nearly refers to:
- A. a fictional story the narrator has read.
  - B. a movie the narrator saw at a theater.
  - C. the work of reason in linking a person to the outer world.
  - D. a fantasy created by the mind.
28. The narrator uses the images in lines 3–5 primarily to depict the interior life’s tendency to engage in:
- F. deceptive self-absorption.
  - G. vital self-examination.
  - H. useful analysis of nature.
  - J. fierce debates with itself.
29. Which of the following statements best paraphrases lines 5–8?
- A. The imagination lacks value and should be ignored in favor of paying attention to the actual world.
  - B. Reason can enhance the imagination but at the expense of experience in the actual world.
  - C. Rather than become isolated, the imagination should connect to the actual world at least occasionally.
  - D. Reason, not the imagination, is the best way to appreciate and enrich the actual world.
30. By her statements in lines 77–80, the narrator is most nearly asserting that:
- F. in her world, adults are generally considered more important than children.
  - G. she, like everyone and everything else, was a small part of a larger world.
  - H. it still mattered greatly whether people saw or ignored her.
  - J. she was less valuable than other people in her world.

## Passage IV

**NATURAL SCIENCE:** This passage is adapted from “Publish and Punish: Science’s Snowball Effect” by Jon Van (©1997 by The Chicago Tribune Company).

It’s a scientific finding so fundamental that it certainly will make the history books and maybe snag a Nobel Prize if it pans out, but the notion that cosmic snowballs are constantly pelting Earth is something  
5 Louis Frank just as soon would have ducked.

Frank is the University of Iowa physicist whose research led him to declare more than a decade ago that Earth is being bombarded by hundreds of house-sized comets day after day that rain water on our planet and  
10 are the reason we have oceans. That weather report caused the widely respected scientist to acquire a certain reputation among his colleagues as a bit unstable, an otherwise estimable fellow whose hard work may have pushed him over the edge.

Frank and his associate, John Sigwarth, probably went a way toward salvaging their reputations when they presented new evidence that leaves little doubt Earth is indeed being bombarded by *something* in a manner consistent with Frank’s small-comet theory.  
20 Rather than gloating or anticipating glory, Frank seemed relieved that part of a long ordeal was ending. “I knew we’d be in for it when we first put forth the small-comet theory,” Frank conceded, “but I was naive about just how bad it would be. We were outvoted by  
25 about 10,000 to 1 by our colleagues. I thought it would have been more like 1,000 to 1.”

To the non-scientist this may seem a bit strange. After all, the point of science is to discover information and insights about how nature works. Shouldn’t every  
30 scientist be eager to overturn existing ideas and replace them with his or her own? In theory, that is the case, but in practice, scientists are almost as loath to embrace radically new ideas as the rest of us.

“Being a scientist puts you into a constant schizophrenic existence,” contends Richard Zare, chairman of the National Science Board. “You have to believe and yet question beliefs at the same time. If you are a complete cynic and believe nothing, you do nothing and get  
40 nowhere, but if you believe too much, you fool yourself.”

It was in the early 1980s when the small-comet theory started to haunt Frank and Sigwarth, who was Frank’s graduate student studying charged particles called plasmas, which erupt from the sun and cause the  
45 aurora borealis (northern lights). As they analyzed photos of the electrical phenomena that accompany sunspots, they noted dark specks appearing in several images from NASA’s Dynamics Explorer 1 satellite. They assumed these were caused by static in the transmission.  
50

After a while their curiosity about the dark spots grew into a preoccupation, then bordered on obsession.

Try as they did, the scientists couldn’t find any plausible explanation of the pattern of dark spots that  
55 appeared on their images. The notion that the equipment was picking up small amounts of water entering Earth’s upper atmosphere kept presenting itself as the most likely answer.

Based on their images, the Iowa scientists estimated 20 comets an hour—each about 30 feet or so across and carrying 100 tons of water—were bombarding the Earth. At that rate, they would produce water vapor that would add about an inch of water to the planet every 10,000 years, Frank concluded. That may  
60 not seem like much, but when talking about a planet billions of years old, it adds up.

Such intimate interaction between Earth and space suggests a fundamentally different picture of human evolution—which depends on water—than is commonly presented by scientists. Frank had great difficulty getting his ideas into a physics journal 11 years ago and was almost hooted from the room when he presented his theory at scientific meetings. Despite the derision, colleagues continued to respect Frank’s main-  
70 stream work on electrically charged particles in space and the imaging cameras he designed that were taken aboard recent NASA spacecraft to explore Earth’s polar regions.

Unbeknown to most, in addition to gathering  
80 information on the northern lights, Frank and Sigwarth designed the equipment to be able to snatch better views of any small comets the spacecraft might happen upon. It was those images from the latest flights that caused even harsh critics of the small-comet theory to  
85 concede that some water-bearing objects appear to be entering Earth’s atmosphere with regularity.

To be sure, it has not been proved that they are comets, let alone that they have anything to do with the oceans. But Frank’s evidence opens the matter up to  
90 study. Had he been a researcher of lesser standing, his theory probably would have died long ago.

31. Which of the following conclusions about new theories in science can reasonably be drawn from the passage?

- A. Important new theories will eventually be accepted, no matter how controversial they are or who proposes them.
- B. Important but unusual new theories have a better chance at acceptance when they are proposed by well-respected scientists.
- C. Research on new, nontraditional theories is widely respected within the scientific community.
- D. Scientists welcome the opportunity to overturn existing ideas in favor of useful new theories.

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32. Which of the following best describes how Frank's colleagues perceived him after he first presented the small-comet theory?
- F. Their doubts about the theory led them to also question his work on particles in space.
  - G. They felt his theory had ruined his reputation as a widely respected scientist.
  - H. He acquired a reputation among them as someone who had worked hard to develop his theory.
  - J. They still respected his traditional research but felt he was overly committed to an improbable theory.
33. The passage indicates that at the time Frank and Sigwarth presented new evidence supporting the small-comet theory, Frank most nearly felt:
- A. relieved but bitter about how he had been treated.
  - B. grateful that ridicule of his work would end.
  - C. proud that he had been proved right.
  - D. satisfied and filled with anticipation of glory.
34. The author uses the fourth paragraph (lines 27–33) primarily to:
- F. continue his earlier criticisms of scientists.
  - G. reveal the role science serves in society.
  - H. present then undermine common perceptions of scientists.
  - J. explain the difference between theoretical and practical scientific research.
35. According to the passage, the research that led to the development of the small-comet theory began with a project originally intended to study:
- A. the electrical activity accompanying sunspots.
  - B. water entering Earth's upper atmosphere.
  - C. static in satellite transmissions.
  - D. specks in satellite images.
36. The main function of lines 64–66 in terms of the eighth paragraph (lines 59–66) as a whole is to:
- F. give a sense of proportion to the numbers provided earlier in the paragraph.
  - G. point out the limitations of the evidence provided by the Iowa scientists.
  - H. supplement the paragraph's description of the comets with additional details about their size and capacity.
  - J. provide readers with a sense of how old the planet really is.
37. It can reasonably be inferred from the passage that within the scientific community the year the passage was published, the small-comet theory was:
- A. tremendously unpopular and condemned for its incompleteness.
  - B. widely accepted and seen as conclusive.
  - C. regarded as tentative but deemed worthy of consideration.
  - D. seen as correct by most scientists but was highly criticized by some.
38. The author italicizes the word *something* in line 18 most likely to emphasize the:
- F. great skepticism with which critics regard Frank and Sigwarth's new evidence.
  - G. remaining uncertainty about what exactly is bombarding Earth.
  - H. lack of doubt among scientists about the small-comet theory's practical value.
  - J. concern among scientists about the usefulness of Frank and Sigwarth's methods of collecting evidence.
39. When Richard Zare says that scientists lead a "constant schizophrenic existence" (lines 34–35), he most nearly means that they:
- A. often suffer psychologically from the demands of their work.
  - B. tend to be either complete cynics or people who believe too much.
  - C. are often guilty of either doing nothing or of fooling themselves.
  - D. have to maintain a balance between accepting and challenging ideas.
40. It can reasonably be inferred that Frank and Sigwarth conducted the study of the dark specks they found with a:
- F. detached, scientific mindset.
  - G. casual interest that developed into a mild curiosity.
  - H. steadily increasing level of involvement.
  - J. great intensity that began when they discovered the specks.

END OF TEST 3

**STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.**  
**DO NOT RETURN TO A PREVIOUS TEST.**

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**SCIENCE TEST***35 Minutes—40 Questions*

**DIRECTIONS:** There are seven passages in this test. Each passage is followed by several questions. After reading a passage, choose the best answer to each question and fill in the corresponding oval on your answer document. You may refer to the passages as often as necessary.

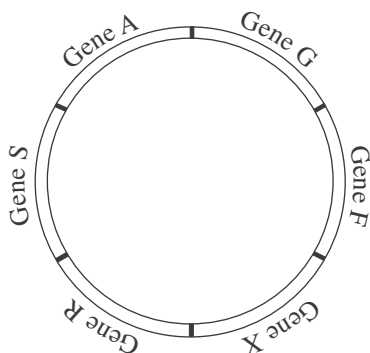
You are NOT permitted to use a calculator on this test.

**Passage I**

Many bacteria contain *plasmids* (small, circular DNA molecules). Plasmids can be transferred from 1 bacterium to another. For this to occur, the plasmid *replicates* (produces a linear copy of itself). The relative position of the genes is the same on the original plasmid and on the linear copy, except that the 2 ends of the linear copy do not immediately connect.

While replication is occurring, 1 end of the linear copy leaves the donor bacterium and enters the recipient bacterium. Thus, the order in which the genes are replicated is the same as the order in which they are transferred. Unless this process is interrupted, the entire plasmid is transferred, and its 2 ends connect in the recipient bacterium.

Four students studied the way in which 6 genes (F, X, R, S, A, and G) on a specific plasmid were donated by a type of bacterium (see the figure). The students determined that the entire plasmid is transferred in 90 min and that the rate of transfer is constant. They also determined that the genes are evenly spaced around the plasmid, so 1 gene is transferred every 15 min. They disagreed, however, about the order in which the genes are replicated and thus transferred. Four models are presented.

*Student 1*

Replication always begins between Gene F and Gene X. Gene X is replicated first and Gene F is replicated last.

*Student 2*

Replication always begins between Gene F and Gene X. However, the direction of replication varies. If Gene F is replicated first, Gene X is replicated last. Conversely, if Gene X is replicated first, Gene F is replicated last.

*Student 3*

Replication can begin between any 2 genes. Replication then proceeds around the plasmid in a clockwise direction (with respect to the figure). Thus, if Gene S is replicated first, Gene A is replicated second, and Gene R is replicated last.

*Student 4*

Replication can begin between any 2 genes. Likewise, replication can proceed in either direction. So the order of replication varies.

- Based on the information presented, if the transfer of the linear copy was interrupted 50 min after transfer began, how many complete genes would have been transferred to the recipient bacterium?

A. 2  
B. 3  
C. 4  
D. 5

- Based on the model presented by Student 3, if all 6 genes are replicated and the first gene replicated is Gene G, the third gene replicated would be:

F. Gene F.  
G. Gene A.  
H. Gene S.  
J. Gene X.



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3. Which students believe that any of the 6 genes on the plasmid can be the first gene transferred to a recipient bacterium?
- A. Students 2 and 3
  - B. Students 2 and 4
  - C. Students 3 and 4
  - D. Students 2, 3, and 4
4. Suppose that the model presented by Student 1 is correct and that the transfer of genes between 2 bacteria was interrupted after 45 min. Based on the information provided, which of the following genes would NOT have been transferred from the donor bacterium to the recipient bacterium?
- F. Gene G
  - G. Gene X
  - H. Gene R
  - J. Gene S
5. Suppose that Student 2's model is correct and that the transfer of genes between 2 bacteria was interrupted after 30 min. Under these conditions, which of the following genes would definitely NOT be transferred from the donor bacterium to the recipient bacterium?
- A. Gene A
  - B. Gene R
  - C. Gene G
  - D. Gene X
6. Suppose that all 6 genes are transferred from a donor bacterium to a recipient bacterium. Under this condition, which student(s) would argue that Gene A could be the last gene transferred?
- F. Student 2 only
  - G. Student 4 only
  - H. Students 2 and 4 only
  - J. Students 3 and 4 only
7. Suppose that the transfer of genes between 2 bacteria was interrupted, that the last gene transferred was Gene A, and that no incomplete copies of a gene were transferred. Based on this information, Student 1 would say that transfer was most likely interrupted how many minutes after the transfer began?
- A. 15
  - B. 30
  - C. 45
  - D. 60

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**Passage II**

Color images of the surface of Io, one of Jupiter's moons, show plumes of gas that resemble Earth's geysers and active volcanoes that emit flows of molten material. The materials ejected from Io's volcanoes and plumes rapidly solidify at Io's cold surface temperatures. Scientists believe that these materials may be one of several *allotropes* (forms) of sulfur (S), or a sulfur compound. The following studies were performed to determine the composition of these materials.

*Study 1*

In a laboratory, scientists measured the *reflectances* (the fraction of light striking a surface that is reflected by that surface) of 4 allotropes of S (red, white, orange, and brown) and of a sulfur compound (sulfur dioxide [ $\text{SO}_2$ ]). Reflectances were measured at visible-light wavelengths between  $0.35\ \mu\text{m}$  (micrometers) and  $0.60\ \mu\text{m}$ . Figure 1 shows the data for the various S allotropes and for  $\text{SO}_2$ .

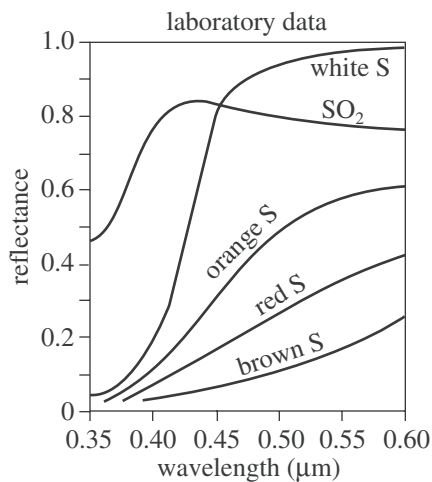


Figure 1

Io's *whole-disk reflectance* (the reflectance of Io's entire visible surface measured all at once) was measured at 2 different times. Figure 2 shows these data along with reflectance data calculated using a computer model. This model shows what combination of materials from Figure 1 would produce the closest match to the measured reflectance data. According to the model, the overall composition of Io's surface is 15%  $\text{SO}_2$ , 50% orange S, 20% red S, and 15% white S.

whole-disk data and computer model

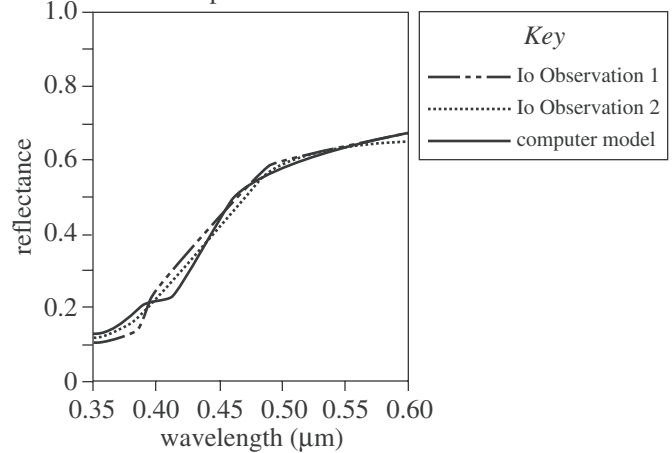


Figure 2

*Study 2*

At 2 different times, reflectances were measured of the crater floors of 2 volcanoes on Io: Pele and Surt. Figure 3 shows the reflectance data.

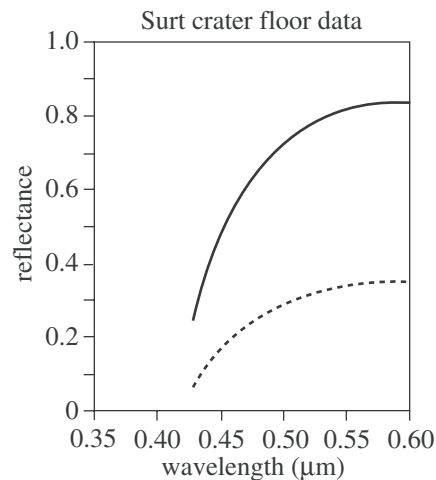
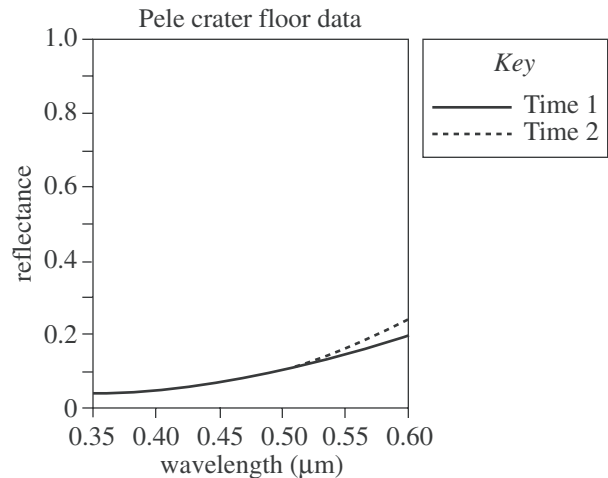


Figure 3

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**Study 3**

Reflectance data were taken from several large plumes and several small plumes on Io. The averaged data are in Figure 4.

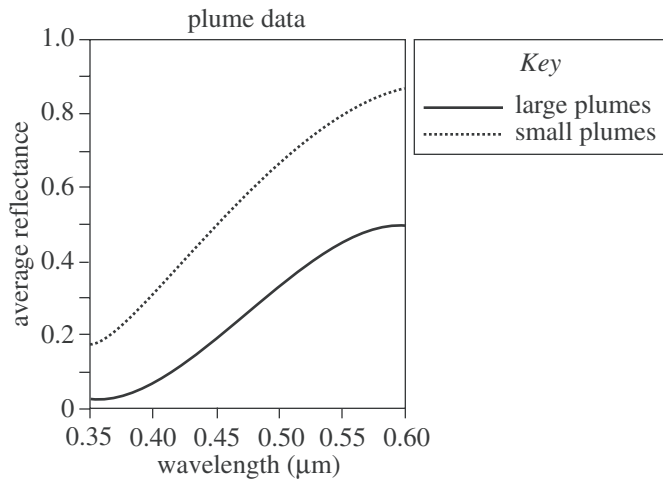


Figure 4

Figures 1, 3, and 4 adapted from Alfred McEwen and Laurence Soderblom, "Two Classes of Volcanic Plumes on Io." ©1983 by Academic Press, Inc.

Figure 2 adapted from Julianne Moses and Douglas Nash, "Phase Transformations and the Spectral Reflectance of Solid Sulfur: Can Metastable Sulfur Allotropes Exist on Io?" ©1991 by Academic Press, Inc.

8. At the wavelengths used in Study 1, as the wavelength of the light increases, the reflectances of the S allotropes and of SO<sub>2</sub> do which of the following?

S allotropes	SO <sub>2</sub>
F. Increase only	Increase only
G. Increase only	Increase, then decrease
H. Decrease only	Decrease only
J. Decrease only	Increase, then decrease

9. According to Study 3, compared with the corresponding average reflectance for small plumes, large plumes on Io have an average reflectance at a given wavelength that is:

A. always higher.  
B. always the same.  
C. always lower.  
D. sometimes higher and sometimes lower.

10. According to Study 1, the reflectance of white S at a wavelength of 0.40 μm is closest to which of the following?

F. 0.0  
G. 0.1  
H. 0.2  
J. 0.3

11. According to Study 1 and Study 2, the crater floor of the volcano Pele has reflectances most similar to which of the following S allotropes?

A. White S  
B. Orange S  
C. Red S  
D. Brown S

12. If the averaged reflectances for large plumes and for small plumes had been measured at a wavelength of 0.61 μm in Study 3, those reflectances would have been closest to which of the following?

	Large plumes	Small plumes
F.	0.2	0.5
G.	0.5	0.2
H.	0.5	0.9
J.	0.9	0.5

13. According to Study 1, white S has a reflectance of 0.98 at a wavelength of 0.60 μm. This means that white S reflects:

A. 2% of the 0.60 μm wavelength light that strikes its surface.  
B. 98% of the 0.60 μm wavelength light that strikes its surface.  
C. 2% of all the visible light that strikes its surface.  
D. 98% of all the visible light that strikes its surface.



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**Passage III**

An electrical circuit contained a 12-volt (V) battery, a *resistor* (a device that resists the flow of electricity), a *capacitor* (a device that stores electrical charge and electrical energy), a *voltmeter* (an instrument for measuring voltage), and a switch, as shown in Figure 1.

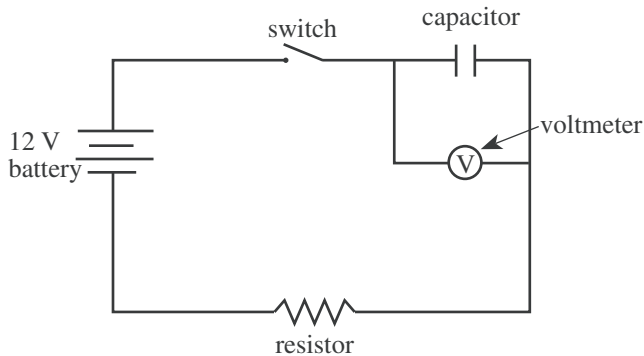


Figure 1

Some students studied the behavior of the circuit.

**Experiment 1**

The students used a  $1 \times 10^7$  ohm ( $\Omega$ ) resistor and a capacitor with a *capacitance* of  $1 \times 10^{-6}$  farad (F). (Capacitance is a measure of the maximum amount of electrical charge and electrical energy a capacitor can store.) The capacitor was initially uncharged. At time zero, the students simultaneously closed the switch and started a stopwatch. At time zero and at 12 sec intervals thereafter, they recorded the voltage across the capacitor. Their results are shown in Table 1.

Table 1	
Time (sec)	Voltage across capacitor (V)
0	0.0
12	8.4
24	10.9
36	11.7
48	11.9
60	12.0

**Experiment 2**

Using the  $1 \times 10^7 \Omega$  resistor and several different capacitors, the students determined the length of time from when the switch was closed until the voltage across the capacitor reached 6 V. Their results are shown in Table 2.

Table 2	
Capacitance ( $\times 10^{-6}$ F)	Time to reach 6 V across capacitor (sec)
1.2	8.3
0.6	4.2
0.3	2.1
0.1	0.7

**Experiment 3**

The students conducted the same procedure described in Experiment 2, except that they used a constant capacitance of  $1 \times 10^{-6}$  F and several different resistors. Their results are shown in Table 3.

Table 3	
Resistance ( $\times 10^7 \Omega$ )	Time to reach 6 V across capacitor (sec)
0.75	5.2
0.50	3.5
0.25	1.7

14. In Experiment 1, the *time constant* of the circuit was the time required for the voltage across the capacitor to reach approximately 7.6 V. The time constant of the circuit used in Experiment 1 was:

F. less than 12 sec.  
 G. between 12 sec and 24 sec.  
 H. between 24 sec and 36 sec.  
 J. greater than 36 sec.

15. If, in Experiment 2, a  $1.5 \times 10^{-6}$  F capacitor had been used, the time required for the voltage across the capacitor to reach 6 V would have been closest to:

A. 4.2 sec.  
 B. 7.0 sec.  
 C. 10.5 sec.  
 D. 15.0 sec.

4



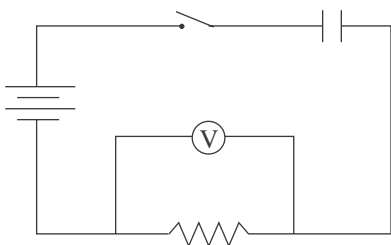
4

16. The main purpose of Experiment 3 was to determine how varying the:

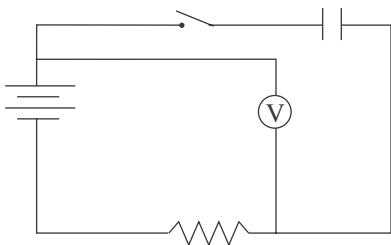
- F. battery's voltage affected the resistor's resistance at a given time.
- G. capacitor's capacitance affected the time required for the voltage across the capacitor to reach a set value.
- H. capacitor's capacitance affected the voltage across the battery at a given time.
- J. resistor's resistance affected the time required for the voltage across the capacitor to reach a set value.

17. Based on Figure 1, to measure the voltage across the resistor only, which of the following circuits should one use?

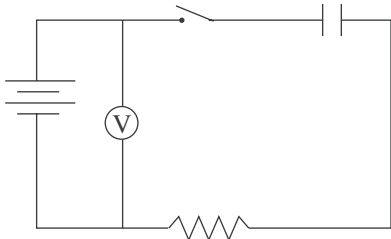
A.



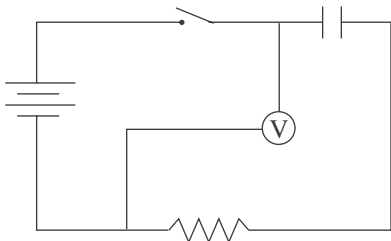
B.



C.



D.



18. Consider a circuit like that shown in Figure 1. Based on Experiments 2 and 3, the voltage across the capacitor will reach a given value in the shortest amount of time if the circuit contains which of the following capacitances and resistances, respectively?

- F.  $0.1 \times 10^{-6} \text{ F}$ ,  $0.3 \times 10^7 \Omega$
- G.  $0.1 \times 10^{-6} \text{ F}$ ,  $1.0 \times 10^7 \Omega$
- H.  $1.2 \times 10^{-6} \text{ F}$ ,  $0.3 \times 10^7 \Omega$
- J.  $1.2 \times 10^{-6} \text{ F}$ ,  $1.0 \times 10^7 \Omega$

19. Consider the following hypothesis: In a circuit arranged as in Figure 1 containing a battery, a capacitor, and a constant resistance, as capacitance increases, the time required to reach a given voltage across the capacitor increases. Do the experiments support this hypothesis?

- A. Yes; in Experiment 1, as capacitance increased, the time required to reach a given voltage increased.
- B. Yes; in Experiment 2, as capacitance increased, the time required to reach a given voltage increased.
- C. No; in Experiment 1, as capacitance increased, the time required to reach a given voltage decreased.
- D. No; in Experiment 2, as capacitance increased, the time required to reach a given voltage decreased.

4



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**Passage IV**

A *bomb calorimeter* is used to determine the amount of heat released when a substance is burned in oxygen (Figure 1). The heat, measured in kilojoules (kJ), is calculated from the change in temperature of the water in the bomb calorimeter. Table 1 shows the amounts of heat released when different foods were burned in a bomb calorimeter. Table 2 shows the amounts of heat released when different amounts of sucrose (table sugar) were burned. Table 3 shows the amounts of heat released when various chemical compounds were burned.

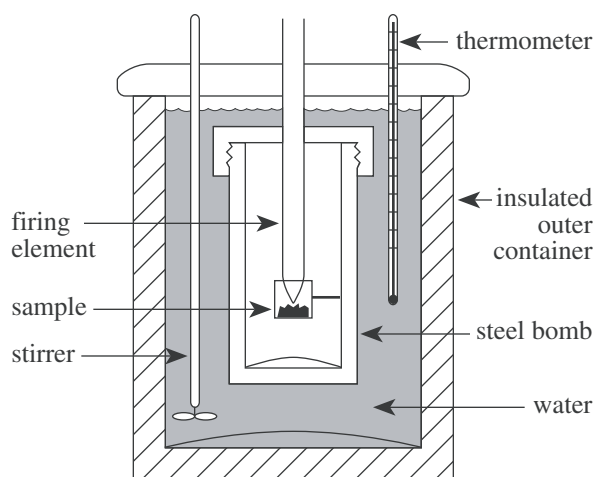


Figure 1

Figure 1 adapted from Antony C. Wilbraham, Dennis D. Staley, and Michael S. Matta, *Chemistry*. ©1995 by Addison-Wesley Publishing Company, Inc.

Table 1			
Food	Mass (g)	Change in water temperature (°C)	Heat released (kJ)
Bread	1.0	8.3	10.0
Cheese	1.0	14.1	17.0
Egg	1.0	5.6	6.7
Potato	1.0	2.7	3.2

Table 1 adapted from American Chemical Society, *ChemCom: Chemistry in the Community*. ©1993 by American Chemical Society.

Table 2	
Amount of sucrose (g)	Heat released (kJ)
0.1	1.6
0.5	8.0
1.0	16.0
2.0	32.1
4.0	64.0

Table 3			
Chemical compound	Molecular formula	Mass (g)	Heat released (kJ)
Methanol	CH <sub>3</sub> OH	0.5	11.4
Ethanol	C <sub>2</sub> H <sub>5</sub> OH	0.5	14.9
Benzene	C <sub>6</sub> H <sub>6</sub>	0.5	21.0
Octane	C <sub>8</sub> H <sub>18</sub>	0.5	23.9

20. According to Tables 1 and 2, as the mass of successive sucrose samples increased, the change in the water temperature produced when the sample was burned most likely:

F. increased only.  
 G. decreased only.  
 H. increased, then decreased.  
 J. remained the same.

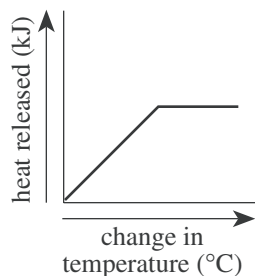
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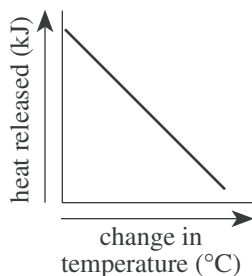
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21. Which of the following graphs best illustrates the relationship between the heat released by the foods listed in Table 1 and the change in water temperature?

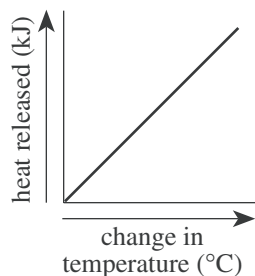
A.



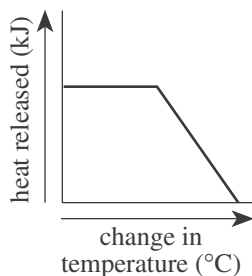
C.



B.



D.



22. Based on the data in Table 2, one can conclude that when the mass of sucrose is decreased by one-half, the amount of heat released when it is burned in a bomb calorimeter will:

- F. increase by one-half.
- G. decrease by one-half.
- H. increase by one-fourth.
- J. decrease by one-fourth.

23. Which of the following lists the foods from Tables 1 and 2 in increasing order of the amount of heat released per gram of food?

- A. Potato, egg, bread, sucrose, cheese
- B. Sucrose, cheese, bread, egg, potato
- C. Bread, cheese, egg, potato, sucrose
- D. Sucrose, potato, egg, bread, cheese

24. Based on the information in Tables 1 and 2, the heat released from the burning of 5.0 g of potato in a bomb calorimeter would be closest to which of the following?

- F. 5 kJ
- G. 10 kJ
- H. 15 kJ
- J. 20 kJ

4



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**Passage V**

Density is defined as the mass of a substance divided by its volume:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

Table 1 lists the phases and the densities, in grams per cubic centimeter ( $\text{g/cm}^3$ ), of various pure substances at  $25^\circ\text{C}$  and 1 atmosphere (atm) of pressure.

Table 1		
Substance	Phase	Density ( $\text{g/cm}^3$ )
Arsenic	solid	5.73
Glucose	solid	1.56
Iron	solid	7.86
Lead	solid	11.34
Zinc	solid	7.14
Ethanol	liquid	0.79
Ethyl ether	liquid	0.71
Glycerol	liquid	1.26
Mercury	liquid	13.59
Freon-12	gas	0.00495
Krypton	gas	0.00343
Methane	gas	0.00065

Figure 1 shows how the density of liquid water changes with temperature.

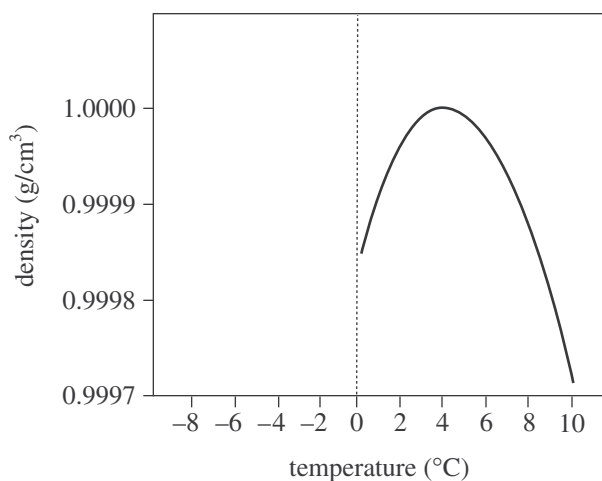


Figure 1

Figure 2 shows how the density of solid water changes with temperature.

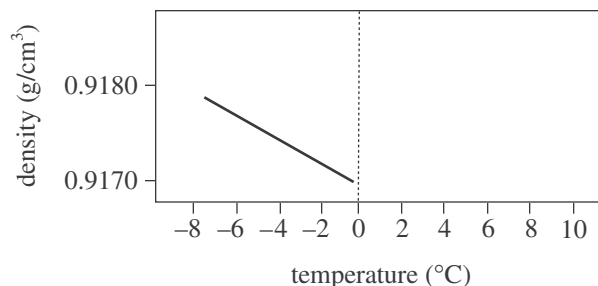


Figure 2

Figures adapted from John C. Kotz and Keith F. Purcell, *Chemistry & Chemical Reactivity*. ©1987 by CBS College Publishing.

25. According to Figure 1, as the temperature of liquid water decreases from  $10^\circ\text{C}$  to  $0^\circ\text{C}$ , the density:
- increases only.
  - decreases only.
  - decreases, then increases.
  - increases, then decreases.
26. A student claimed that "If the masses of  $1\text{ cm}^3$  of any solid and  $1\text{ cm}^3$  of any liquid are compared, the mass of the solid will be greater." Do the data in Table 1 support his claim?
- No; lead has a higher density than any of the liquids listed.
  - No; mercury has a higher density than any of the solids listed.
  - Yes; lead has a higher density than any of the liquids listed.
  - Yes; mercury has a higher density than any of the solids listed.
27. Which of the following hypotheses about the relationship between the temperature and the density of a solid is best supported by the data in Figure 2? As the temperature of a solid increases, the density of the solid:
- increases only.
  - decreases only.
  - increases, then decreases.
  - decreases, then increases.

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28. Equal amounts of ethyl ether, mercury, and water (density =  $0.9971 \text{ g/cm}^3$ ) at  $25^\circ\text{C}$  are poured into a single beaker. Three distinct layers of liquid form in the beaker. Based on the data in Table 1, which of the following diagrams represents the order, from top to bottom, of the liquids in the beaker?

F.

Ethyl ether
Water
Mercury

G.

Ethyl ether
Mercury
Water

H.

Mercury
Water
Ethyl ether

J.

Water
Ethyl ether
Mercury

29. According to Figure 1, 100 g of water at  $4^\circ\text{C}$  would exactly fill a container having which of the following volumes?

- A.  $1 \text{ cm}^3$
- B.  $10 \text{ cm}^3$
- C.  $100 \text{ cm}^3$
- D.  $1,000 \text{ cm}^3$

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**Passage VI**

The clearing of rain forests results in *forest fragmentation* (the breakup of large forest tracts into small patches). Researchers predicted that fragmentation would result in a decrease in animal populations and *aboveground tree biomass* (AGTB) in the resulting fragments. They did 4 studies to test this prediction.

**Study 1**

The researchers monitored the AGTB of twenty-five 100 m  $\times$  100 m forest plots near areas that had recently been cleared of vegetation. The distance from the center of each plot to the nearest clearing was measured. Figure 1 shows the average change per plot in AGTB in metric tons per year (t/yr) over 17 yr.

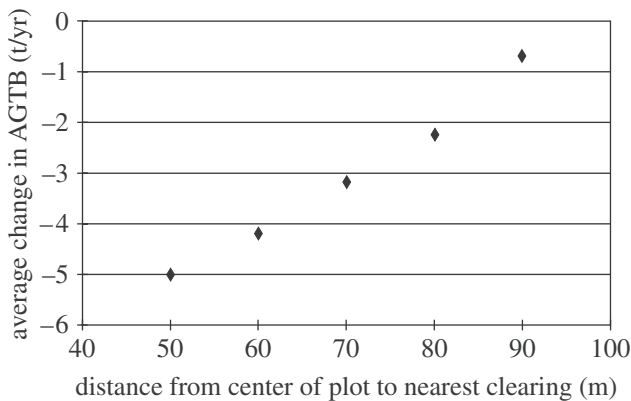


Figure 1

**Study 2**

Twenty-five 100 m  $\times$  100 m forest plots were monitored as in Study 1. The center of each of these plots was at least 500 m from the nearest clearing. The average change in AGTB over 17 yr for these 25 plots was 0 t/yr.

**Study 3**

Researchers monitored sixteen 100 m  $\times$  100 m forest plots near areas that had recently been cleared of vegetation. Each plot was bordered on 1 side by a clearing. Figure 2 shows the average cumulative percent change in AGTB at these plots following fragmentation. (Note: Year 0 represents results prior to fragmentation.)

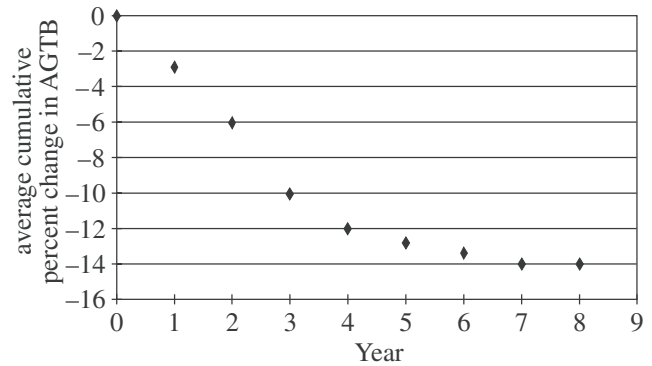


Figure 2

**Study 4**

Researchers trapped and released birds in 10 forest fragments adjacent to areas that had recently been cleared of vegetation. Three types of birds were monitored: insectivores, frugivores (fruit eaters), and hummingbirds. Figure 3 shows the number of captures per 1,000 hours (hr) of trapping. (Note: Year 0 represents results prior to fragmentation.)

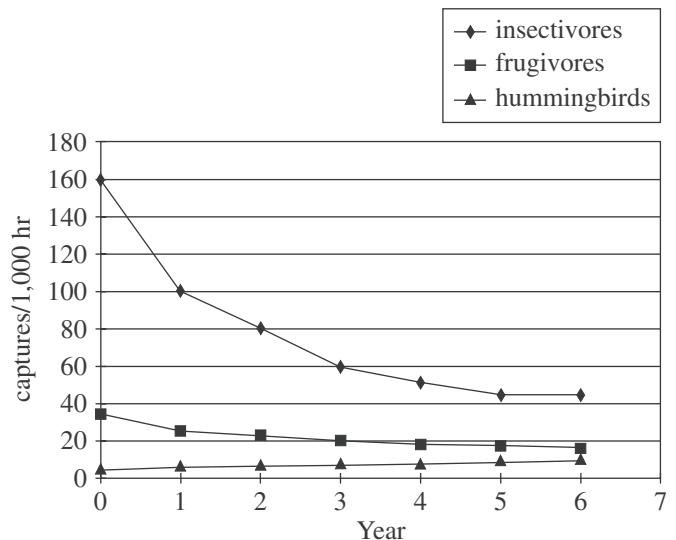


Figure 3

Figures adapted from William F. Laurance et al., "Biomass Collapse in Amazonian Forest Fragments." ©1998 by the American Association for the Advancement of Science.

4



4

30. In Study 4, as time increased from Year 0 to Year 6, the captures/1,000 hr of frugivores:
- F. decreased only.
  - G. increased only.
  - H. decreased, then increased.
  - J. increased, then decreased.
31. Based on the results of Study 4, how did fragmentation most likely affect the population sizes of insectivores and hummingbirds in the fragments studied?
- A. Fragmentation increased the population sizes of both insectivores and hummingbirds.
  - B. Fragmentation decreased the population sizes of both insectivores and hummingbirds.
  - C. Fragmentation increased the population size of insectivores and decreased the population size of hummingbirds.
  - D. Fragmentation decreased the population size of insectivores and increased the population size of hummingbirds.
32. Based on the results of Study 1, if the distance from the center of a  $100\text{ m} \times 100\text{ m}$  plot were 75 m from the nearest clearing, the expected average change in AGTB at the plot over 17 yr would be closest to which of the following values?
- F.  $-1.1\text{ t/yr}$
  - G.  $-2.6\text{ t/yr}$
  - H.  $+1.1\text{ t/yr}$
  - J.  $+2.6\text{ t/yr}$
33. After examining the results of Study 2, a student concluded that the AGTB at each of the 25 plots remained constant. Which of the following alternative explanations is also consistent with the results?
- A. The AGTB at all 25 plots increased.
  - B. The AGTB at all 25 plots decreased.
  - C. The AGTB at some of the plots increased and the AGTB at some of the plots decreased.
  - D. The AGTB at plots bounded by forest increased and the AGTB at plots bounded by clearings remained constant.
34. Which of the following sets of results from the studies is *least* consistent with the prediction proposed by the researchers?
- F. The results of Study 1 for AGTB
  - G. The results of Study 3 for AGTB
  - H. The results of Study 4 for frugivores
  - J. The results of Study 4 for hummingbirds
35. In Study 4, the researchers trapped birds for 10,000 hr per year. Thus, how many insectivores were trapped in Year 2 ?
- A. 80
  - B. 100
  - C. 800
  - D. 1,000



4



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### Passage VII

Glaciers deposit *till* (a poorly sorted sediment). If glaciers repeatedly advance over an area and then melt back, thick till deposits may form. Figure 1 shows a vertical core taken through layers of till, non-glacial sediments, and bedrock at a site in Canada. The *resistivity* (an electrical property of a material) and CO<sub>2</sub> measurements taken along the core are also shown. Resistivity is related to a sediment's particle sizes, compaction, and mineral composition. Table 1 shows the average percent sand, silt, and clay contents and descriptions of the various till layers.

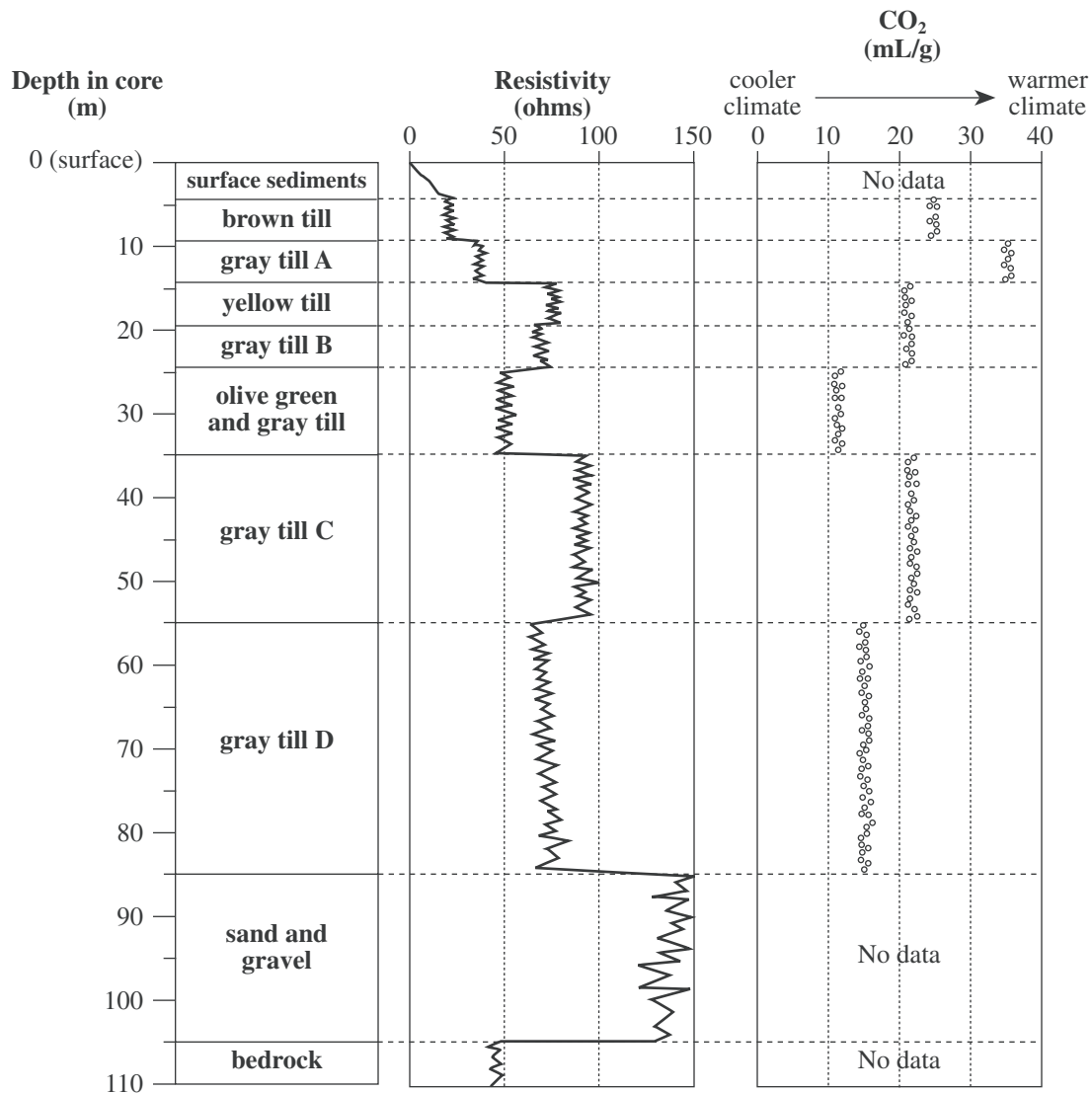


Figure 1

4



4

Table 1				
Depth of till layer (m)	Description of till	Average percent by volume of:		
		larger particle → smaller particle		
		sand	silt	clay
4–9	brown (oxidized*)	54.1	31.7	14.2
9–14	gray A	44.8	36.6	18.6
14–19	yellow (oxidized)	43.5	31.7	24.8
19–24	gray B	37.4	34.3	28.3
24–35	olive green and gray	25.5	34.3	40.2
35–55	gray C	31.7	33.6	34.7
55–85	gray D	37.5	31.7	30.8
*Oxidized sediments have at some time been exposed to the air. Sediments that have been <i>deprived</i> of oxygen will be gray or green.				

Figure 1 and Table 1 adapted from E. A. Christiansen, "Pleistocene Stratigraphy of the Saskatoon Area, Saskatchewan, Canada: An Update." ©1992 by the Geological Association of Canada.

36. A sample of gray till was recovered from another core taken from a nearby area. The table below shows the results of an analysis of the sample.

Percent by volume of:			Resistivity (ohms)	CO <sub>2</sub> content (mL/g)
sand	silt	clay		
31.5	33.7	34.8	85	22

Based on these data and the data provided in Figure 1 and Table 1, the sample of gray till corresponds most closely with which till from Figure 1 ?

- F. Gray till A  
G. Gray till B  
H. Gray till C  
J. Gray till D
37. According to Figure 1, the *oldest* glacial advance in this area deposited which of the following till layers?  
A. Gray till A  
B. Yellow till  
C. Olive green and gray till  
D. Gray till D
38. According to Figure 1, which of the following statements best describes how the resistivity of the sand and gravel layer compares to the resistivity of the till layers? The resistivity measured in the sand and gravel layer is:  
F. lower than the resistivities measured in any of the till layers.  
G. higher than the resistivities measured in any of the till layers.  
H. the same as the resistivities measured in the surface sediments.  
J. lower than the resistivities measured in the bedrock.
39. The average resistivity of the bedrock in the core is most similar to the average resistivity of which of the following till layers?  
A. Yellow till  
B. Gray till B  
C. Olive green and gray till  
D. Gray till C
40. The sediments being deposited at the present time at the site where the core was taken have a much higher CO<sub>2</sub> content than any of the tills. Given this information and the information in Figure 1, the CO<sub>2</sub> content of sediments recently deposited at the site would most likely be in which of the following ranges?  
F. Less than 10 mL/g  
G. Between 10 mL/g and 25 mL/g  
H. Between 25 mL/g and 35 mL/g  
J. Greater than 35 mL/g

**END OF TEST 4**

**STOP! DO NOT RETURN TO ANY OTHER TEST.**

[See Note on page 56.]

**Note:** If you plan to take the ACT Plus Writing, take a 5-minute break and then continue with the Writing Test on page 57.

If you do not plan to take the ACT Plus Writing, turn to page 59 for instructions on scoring your multiple-choice tests.

## Practice Writing Test

Your Signature (do not print): \_\_\_\_\_

Print Your Name Here: \_\_\_\_\_

Your Date of Birth:									
<input type="text"/>	<input type="text"/>	-	<input type="text"/>	<input type="text"/>	-	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Month		Day		Year					

### Form 06A

# The ACT<sup>®</sup> Writing Test Booklet

**You must take the multiple-choice tests before you take the Writing Test.**

## Directions

This is a test of your writing skills. You will have thirty (30) minutes to write an essay in English. Before you begin planning and writing your essay, read the writing prompt carefully to understand exactly what you are being asked to do. Your essay will be evaluated on the evidence it provides of your ability to express judgments by taking a position on the issue in the writing prompt; to maintain a focus on the topic throughout the essay; to develop a position by using logical reasoning and by supporting your ideas; to organize ideas in a logical way; and to use language clearly and effectively according to the conventions of standard written English.

You may use the unlined pages in this test booklet to plan your essay. These pages will not be scored. ***You must write your essay in pencil on the lined pages in the answer folder.*** Your writing on those lined pages will be scored. You may not need all the lined pages, but to ensure you have enough room to finish, do NOT skip lines. You may write corrections or additions neatly between the lines of your essay, but do NOT write in the margins of the lined pages. ***Illegible essays cannot be scored, so you must write (or print) clearly.***

If you finish before time is called, you may review your work. Lay your pencil down immediately when time is called.

**DO NOT OPEN THIS BOOKLET UNTIL TOLD TO DO SO.**

## **ACT Assessment Writing Test Prompt**

Many high school libraries use some of their limited funding to subscribe to popular magazines with articles that are interesting to students. Despite limited funding, some educators support this practice because they think having these magazines available encourages students to read. Other educators think school libraries should not use limited funds to subscribe to these magazines because they may not be related to academic subjects. In your opinion, should high school libraries subscribe to popular magazines?

In your essay, take a position on this question. You may write about either one of the two points of view given, or you may present a different point of view on this question. Use specific reasons and examples to support your position.

### **Note**

- Your test booklet will have blank space for you to plan your essay. For this practice test, use scratch paper.
- You may wish to remove pages 75–78 to respond to this prompt.
- When you have completed your essay, read pages 66–71 for information and instructions on scoring your practice Writing Test.

# 5 Scoring Your Tests

## How to Score the Multiple-Choice Tests

Follow the instructions below and on the following pages to score your practice multiple-choice tests and to evaluate your performance.

### Raw Scores

The number of questions you answered correctly on each test and in each subscore area is your raw score. Because there are many forms of the ACT, each containing different questions, some forms will be slightly easier (and some slightly harder) than others. A raw score of 67 on one form of the English Test, for example, may be about as difficult to earn as a raw score of 70 on another form of that test.

To compute your raw scores, check your answers with the scoring keys on pages 60–62. Count the number of correct answers for each of the four tests and seven subscore areas, and enter the number in the blanks provided on those pages. These numbers are your raw scores on the tests and subscore areas.

### Scale Scores

To adjust for the small differences that occur among different forms of the ACT, the raw scores for tests and subscore areas are converted into *scale scores*. Scale scores are printed on the reports sent to you and your college and scholarship choices.

When your raw scores are converted into scale scores, it becomes possible to compare your scores with those of examinees who took different test forms. For example, a scale score of 26 on the English Test has the same meaning regardless of the form of the ACT on which it is based.

To determine the scale scores corresponding to your raw scores on the practice test, use the score conversion tables on pages 63–64. Table 1 on page 63 shows the raw-to-scale score conversions for each test, and Table 2 on page 64 shows the raw-to-scale score conversions for the subscore areas. Because each form of the ACT is unique, each form has somewhat different conversion tables. Consequently, these tables provide only approximations of the raw-to-scale score conversions that would apply if a different form of the ACT were taken. Therefore, the scale scores obtained from the practice tests don't match precisely the scale scores received from a national administration of the ACT.

### Computing the Composite Score

The Composite score is the average of the four scale scores in English, Mathematics, Reading, and Science. If you left any of these tests blank, a Composite score cannot be calculated. If you take the ACT Plus Writing, your Writing results do **not** affect your Composite score.

### Comparing Your Scores

Even scale scores don't tell the whole story of your test performance. You may want to know how your scores compare to the scores of other students who took the ACT.

The multiple-choice norms table (Table 3A on page 65) enables you to compare your scores on the practice multiple-choice tests with the scores of recent high school graduates who tested as sophomores, juniors, or seniors. The numbers reported in Table 3A are cumulative percents. A cumulative percent is the percent of students who scored *at or below* a given score. For example, a Composite score of 20 has a cumulative percent of 48. This means that 48% of the ACT-tested high school students had a Composite score of 20 or lower.

Remember that your scores and percent at or below on the practice test are only *estimates* of the scores that you will obtain during an actual administration of the ACT. Test scores are only one indicator of your level of academic knowledge and skills. Consider your scores in connection with your grades, your performance in outside activities, and your career interests.

### College Readiness Standards™

To add to the information you receive about your performance on the ACT, we have developed College Readiness Standards. These standards help you to more fully understand what your total test score means for each academic area assessed: English, Mathematics, Reading, Science, and Writing. The College Readiness Standards describe the types of skills, strategies, and understandings you will need to make a successful transition from high school to college. For English, Mathematics, Reading, and Science, standards are provided for six score ranges that reflect the progression and complexity of the skills measured by the ACT tests. For Writing, standards are provided for five score ranges. The College Readiness Standards and benchmark scores for each test can be found at [www.act.org/standard](http://www.act.org/standard).

## Reviewing Your Performance on the Practice Multiple-Choice Tests

After you have determined your scale scores, consider the following as you evaluate your performance.

- Did you run out of time? If so, reread the information in this booklet on pacing yourself. Perhaps you need to adjust the way you used your time in responding to the questions. It is to your advantage to answer every question. There is no penalty for guessing.
- Did you spend too much time trying to understand the directions for the tests? The directions for the practice tests are exactly like the directions that will appear in your test booklet on test day. Make sure you understand them now, so you won't have to spend too much time studying them on test day.
- Review the questions that you missed. Did you select a response that was an incomplete answer or that did not directly respond to the question being asked? Try to figure out what you overlooked in answering the questions.
- Did a particular type of question confuse you? Did the questions you missed come from a particular subscore area? In reviewing your responses, check to see whether a particular type of question or a particular subscore area was more difficult for you or took more time.

### Scoring Keys for the ACT Practice Tests

Use the scoring key for each test to score your answer document for the multiple-choice tests. Mark a "1" in the blank for each question you answered correctly. Add up the numbers in each subscore area and enter the total number correct for each subscore area in the blanks provided. Also enter the total number correct for each test in the blanks provided. The total number correct for each test is the sum of the number correct in each subscore area.

#### Test 1: English—Scoring Key

Subscore Area*			Subscore Area*			Subscore Area*		
Key	UM	RH	Key	UM	RH	Key	UM	RH
1. D			26. F			51. C		
2. F			27. A			52. H		
3. B			28. H			53. B		
4. J			29. D			54. J		
5. A			30. G			55. D		
6. G			31. C			56. J		
7. A			32. J			57. C		
8. G			33. A			58. H		
9. A			34. H			59. B		
10. J			35. C			60. J		
11. C			36. G			61. C		
12. J			37. D			62. F		
13. A			38. H			63. B		
14. G			39. A			64. F		
15. C			40. J			65. D		
16. J			41. C			66. H		
17. B			42. F			67. B		
18. J			43. C			68. G		
19. A			44. F			69. C		
20. F			45. D			70. J		
21. C			46. G			71. D		
22. F			47. A			72. F		
23. A			48. G			73. B		
24. J			49. D			74. H		
25. B			50. G			75. D		

Number Correct (Raw Score) for:	
Usage/Mechanics (UM) Subscore Area	(40)
Rhetorical Skills (RH) Subscore Area	(35)
Total Number Correct for English Test (UM + RH)	(75)

\* UM = Usage/Mechanics  
RH = Rhetorical Skills

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**Test 2: Mathematics—Scoring Key**

Subscore Area*					Subscore Area*				
Key		EA	AG	GT	Key		EA	AG	GT
1.	A	_____			31.	E		_____	
2.	K	_____			32.	F			_____
3.	B	_____			33.	C	_____		
4.	G		_____		34.	J	_____		
5.	E	_____			35.	B			_____
6.	H	_____			36.	K		_____	
7.	E	_____			37.	C		_____	
8.	G	_____			38.	J		_____	
9.	B			_____	39.	C			_____
10.	J		_____		40.	H		_____	
11.	E	_____			41.	A	_____		
12.	J		_____		42.	F		_____	
13.	B	_____			43.	D		_____	
14.	G			_____	44.	F			_____
15.	C			_____	45.	C			_____
16.	G			_____	46.	K			_____
17.	A	_____			47.	C	_____		
18.	H			_____	48.	J	_____		
19.	C	_____			49.	D		_____	
20.	K	_____			50.	J		_____	
21.	B	_____			51.	E	_____		
22.	K		_____		52.	J	_____		
23.	A	_____			53.	A		_____	
24.	F	_____			54.	K			_____
25.	D			_____	55.	B			_____
26.	J		_____		56.	H			_____
27.	A	_____			57.	A		_____	
28.	H	_____			58.	K			_____
29.	C			_____	59.	E		_____	
30.	G			_____	60.	J		_____	

Number Correct (Raw Score) for:	
Pre-Alg./Elem. Alg. (EA) Subscore Area	(24)
Inter. Alg./Coord. Geo. (AG) Subscore Area	(18)
Plane Geo./Trig. (GT) Subscore Area	(18)
Total Number Correct for Math Test (EA + AG + GT)	(60)

\* EA = Pre-Algebra/Elementary Algebra  
AG = Intermediate Algebra/Coordinate Geometry  
GT = Plane Geometry/Trigonometry

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### Test 3: Reading—Scoring Key

Subscore Area*			Subscore Area*			Subscore Area*		
Key	SS	AL	Key	SS	AL	Key	SS	AL
1. B			15. D			29. C		
2. J			16. G			30. G		
3. C			17. A			31. B		
4. F			18. F			32. J		
5. C			19. C			33. B		
6. J			20. H			34. H		
7. A			21. A			35. A		
8. H			22. H			36. F		
9. D			23. C			37. C		
10. G			24. J			38. G		
11. B			25. D			39. D		
12. F			26. G			40. H		
13. D			27. D					
14. J			28. F					

#### Number Correct (Raw Score) for:

Social Studies/Sciences (SS) Subscore Area	
	(20)
Arts/Literature (AL) Subscore Area	
	(20)
Total Number Correct for Reading Test (SS + AL)	
	(40)

\* SS = Social Studies/Sciences  
AL = Arts/Literature

### Test 4: Science—Scoring Key

Key	Key	Key
1. B	15. C	29. C
2. J	16. J	30. F
3. C	17. A	31. D
4. F	18. F	32. G
5. A	19. B	33. C
6. J	20. F	34. J
7. D	21. B	35. C
8. G	22. G	36. H
9. C	23. A	37. D
10. H	24. H	38. G
11. D	25. D	39. C
12. H	26. G	40. J
13. B	27. B	
14. F	28. F	

#### Number Correct (Raw Score) for:

Total Number Correct for Science Test	
	(40)

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**TABLE 1****Procedures Used to Obtain Scale Scores From Raw Scores for the ACT Practice Tests**

On each of the four multiple-choice tests on which you marked any responses, the total number of correct responses yields a raw score. Use the table below to convert your raw scores to scale scores. For each test, locate and circle your raw score or the range of raw scores that includes it in the table below. Then, read across to either outside column of the table and circle the scale score that corresponds to that raw score. As you determine your scale scores, enter them in the blanks provided on the right. The highest possible scale score for each test is 36. The lowest possible scale score for any test on which you marked any response is 1.

Next, compute the Composite score by averaging the four scale scores. To do this, add your four scale scores and divide the sum by 4. If the resulting number ends in a fraction, round it off to the nearest whole number. (Round down any fraction less than one-half; round up any fraction that is one-half or more.) Enter this number in the blank. This is your Composite score. The highest possible Composite score is 36. The lowest possible Composite score is 1.

	<b><u>Your Scale Score</u></b>
English	_____
Mathematics	_____
Reading	_____
Science	_____
<b>Sum of scores</b>	_____
<b>Composite score (sum ÷ 4)</b>	_____

NOTE: If you left a test completely blank and marked no items, do not list a scale score for that test. If any test was completely blank, do not calculate a Composite score.

Scale Score	Raw Scores				Scale Score
	Test 1 English	Test 2 Mathematics	Test 3 Reading	Test 4 Science	
36	75	60	38-40	40	36
35	73-74	58-59	37	—	35
34	71-72	56-57	36	39	34
33	70	55	35	—	33
32	69	54	34	38	32
31	68	52-53	—	—	31
30	67	50-51	33	37	30
29	65-66	48-49	32	36	29
28	64	46-47	30-31	35	28
27	62-63	43-45	29	34	27
26	60-61	41-42	28	32-33	26
25	57-59	39-40	27	30-31	25
24	55-56	37-38	26	29	24
23	53-54	35-36	25	27-28	23
22	50-52	33-34	24	25-26	22
21	47-49	31-32	23	23-24	21
20	44-46	30	22	21-22	20
19	42-43	27-29	21	18-20	19
18	39-41	25-26	20	16-17	18
17	37-38	22-24	19	14-15	17
16	34-36	18-21	17-18	13	16
15	30-33	15-17	16	12	15
14	28-29	12-14	14-15	10-11	14
13	26-27	09-11	12-13	09	13
12	24-25	08	10-11	08	12
11	22-23	06-07	08-09	07	11
10	20-21	05	07	06	10
9	18-19	04	06	05	9
8	15-17	—	05	04	8
7	13-14	03	—	03	7
6	10-12	02	04	—	6
5	08-09	—	03	02	5
4	06-07	—	02	—	4
3	04-05	01	—	01	3
2	02-03	—	01	—	2
1	00-01	00	00	00	1

TABLE 2

Procedures Used to Obtain Scale Subscores from Raw Scores for the ACT Practice Tests

For each of the seven subscore areas, the total number of correct responses yields a raw score. Use the table below to convert your raw scores to scale subscores. For each of the seven subscore areas, locate and circle either the raw score or the range of raw scores that includes it in the table below. Then, read across to either outside column of the table and circle the scale subscore that corresponds to that raw score. As you determine your scale subscores, enter them in the blanks provided on the right. The highest possible scale subscore is 18. The lowest possible scale subscore is 1.

If you left a test completely blank and marked no responses, do not list any scale subscores for that test.

English	Your Scale Subscore
Usage/Mechanics (UM)	
Rhetorical Skills (RH)	
Mathematics	
Pre-Algebra/Elem. Algebra (EA)	
Inter. Algebra/Coord. Geometry (AG)	
Plane Geometry/Trigonometry (GT)	
Reading	
Social Studies/Sciences (SS)	
Arts/Literature (AL)	

Raw Scores							
Scale Subscore	Test 1 English		Test 2 Mathematics			Test 3 Reading	
	Usage/ Mechanics	Rhetorical Skills	Pre-Algebra/ Elem. Algebra	Inter. Algebra/ Coord. Geometry	Plane Geometry/ Trigonometry	Social Studies/ Sciences	Arts/ Literature
18	39-40	35	23-24	18	18	19-20	20
17	38	33-34	22	17	17	17-18	19
16	36-37	31-32	21	16	16	16	18
15	35	30	20	14-15	14-15	15	17
14	33-34	28-29	18-19	13	13	13-14	16
13	31-32	26-27	17	11-12	11-12	12	15
12	29-30	24-25	16	10	10	—	14
11	27-28	21-23	14-15	9	9	11	13
10	25-26	19-20	13	07-08	07-08	10	12
9	23-24	16-18	12	6	6	9	11
8	20-22	14-15	9-11	5	5	07-08	10
7	17-19	12-13	07-08	4	4	6	9
6	15-16	10-11	05-06	3	3	5	8
5	13-14	08-09	03-04	2	—	05	7
4	10-12	06-07	02	—	02	04	6
3	08-09	04-05	—	01	—	03	5
2	05-07	02-03	01	—	01	02	4
1	00-04	00-01	00	00	00	01-02	3
						00	2
						00	1

## TABLES 3A and 3B

### Norms Tables

Use the norms tables below (3A and 3B) to determine your estimated percent at or below for each of your multiple-choice scale scores (3A), and for your Writing scores (3B), if applicable.

In the far left column of the multiple-choice norms table (3A), circle your scale score for the English Test (from page 63). Then read across to the percent at or below column for that test; circle or put a check mark beside the corresponding percent at or below. Use the same procedure for each test and subscore area. Use the far right column of scale scores in Table 3A, for your Science Test and Composite scores. Follow the same procedure on the Writing Test norms to get your estimated percent at or below for your Writing subscore and Combined English/Writing score.

As you mark your percents at or below, enter them in the blanks provided at the right. You may also find it helpful to compare your performance with the national mean (average) score for each of the tests, subscore areas, and the Composite as shown at the bottom of the norms tables.

### Your Estimated Percent At or Below on Practice Test

#### English

Usage/Mechanics

Rhetorical Skills

#### Mathematics

Pre-Algebra/Elem. Alg.

Alg./Coord. Geometry

Plane Geometry/Trig.

#### Reading

Soc. Studies/Sciences

Arts/Literature

#### Science

#### Composite

#### Combined English/Writing

#### Writing

### 3A

National Distributions of Cumulative Percents for ACT Test Scores  
ACT-Tested High School Graduates from 2005, 2006, and 2007

Score	ENGLISH		MATHEMATICS		READING		SCIENCE		COMPOSITE	Score
	Usage/Mechanics	Rhetorical Skills	Pre-Algebra/Elem. Alg.	Alg./Coord. Geometry	Soc. Studies/Sciences	Arts/Literature				
36	99		99		99		99	99	36	
35	99		99		99		99	99	35	
34	99		99		99		99	99	34	
33	98		99		97		99	99	33	
32	97		98		95		98	99	32	
31	96		97		94		98	98	31	
30	94		96		91		97	97	30	
29	92		94		89		96	95	29	
28	90		92		86		94	92	28	
27	87		89		82		92	89	27	
26	84		85		78		90	85	26	
25	80		80		74		85	81	25	
24	74		75		70		79	75	24	
23	69		69		64		73	69	23	
22	64		63		58		65	63	22	
21	58		58		53		57	56	21	
20	51		53		48		48	48	20	
19	43		47		41		38	40	19	
18	36	99	41	99	34	99	29	33	18	
17	31	98	33	97	30	98	21	26	17	
16	26	93	24	94	24	93	16	19	16	
15	21	90	14	88	19	89	12	13	15	
14	15	85	07	83	15	83	08	08	14	
13	11	78	02	75	09	76	06	05	13	
12	09	72	01	66	06	69	04	02	12	
11	06	64	01	57	03	59	02	01	11	
10	04	55	01	48	01	49	01	01	10	
09	03	44	01	39	01	39	01	01	09	
08	02	34	01	30	01	28	01	01	08	
07	01	25	01	19	01	17	01	01	07	
06	01	17	01	08	01	10	01	01	06	
05	01	10	01	03	01	06	01	01	05	
04	01	06	01	01	01	03	01	01	04	
03	01	02	01	01	01	01	01	01	03	
02	01	01	01	01	01	01	01	01	02	
01	01	01	01	01	01	01	01	01	01	
Mean	20.6	10.3	10.6	20.8	10.9	10.4	20.9	21.1		
S.D.	5.9	3.7	3.1	5.1	3.4	2.9	4.7	4.9		

Note: These norms are the source of national and state norms, for multiple-choice tests, printed on ACT score reports during the 2007–2008 testing year. Sample size: 3,668,596.

### 3B

ACT Writing Test Norms

Score	Combined English/Writing	Writing
36	99	
35	99	
34	99	
33	99	
32	99	
31	97	
30	95	
29	93	
28	90	
27	86	
26	82	
25	77	
24	72	
23	66	
22	57	
21	51	
20	42	
19	35	
18	29	
17	23	
16	19	
15	14	
14	10	
13	7	
12	5	99
11	4	99
10	2	98
9	1	89
8	1	77
7	1	44
6	1	29
5	1	9
4	1	5
3	1	1
2	1	1
1	1	
<hr/>		
Mean	21.4	7.5
S.D.	5.4	1.7

Note: These norms are the source of the Writing Test norms printed on the ACT score reports of students who take the optional Writing Test during 2007–2008. Sample size: 1,718,228.

## **Six-Point Holistic Scoring Rubric for the ACT Writing Test**

Papers at each level exhibit *all or most* of the characteristics described at each score point.

### **Score = 6**

**Essays within this score range demonstrate effective skill in responding to the task.**

The essay shows a clear understanding of the task. The essay takes a position on the issue and may offer a critical context for discussion. The essay addresses complexity by examining different perspectives on the issue, or by evaluating the implications and/or complications of the issue, or by fully responding to counterarguments to the writer's position. Development of ideas is ample, specific, and logical. Most ideas are fully elaborated. A clear focus on the specific issue in the prompt is maintained. The organization of the essay is clear: the organization may be somewhat predictable or it may grow from the writer's purpose. Ideas are logically sequenced. Most transitions reflect the writer's logic and are usually integrated into the essay. The introduction and conclusion are effective, clear, and well developed. The essay shows a good command of language. Sentences are varied and word choice is varied and precise. There are few, if any, errors to distract the reader.

### **Score = 5**

**Essays within this score range demonstrate competent skill in responding to the task.**

The essay shows a clear understanding of the task. The essay takes a position on the issue and may offer a broad context for discussion. The essay shows recognition of complexity by partially evaluating the implications and/or complications of the issue, or by responding to counterarguments to the writer's position. Development of ideas is specific and logical. Most ideas are elaborated, with clear movement between general statements and specific reasons, examples, and details. Focus on the specific issue in the prompt is maintained. The organization of the essay is clear, although it may be predictable. Ideas are logically sequenced, although simple and obvious transitions may be used. The introduction and conclusion are clear and generally well developed. Language is competent. Sentences are somewhat varied and word choice is sometimes varied and precise. There may be a few errors, but they are rarely distracting.

### **Score = 4**

**Essays within this score range demonstrate adequate skill in responding to the task.**

The essay shows an understanding of the task. The essay takes a position on the issue and may offer some context for discussion. The essay may show some recognition of complexity by providing some response to counterarguments to the writer's position. Development of ideas is adequate, with some movement between general statements and specific reasons, examples, and details. Focus on the specific issue in the prompt is maintained throughout most of the essay. The organization of the essay is apparent but predictable. Some evidence of logical sequencing of ideas is apparent, although most transitions are simple and obvious. The introduction and conclusion are clear and somewhat developed. Language is adequate, with some sentence variety and appropriate word choice. There may be some distracting errors, but they do not impede understanding.

### **Score = 3**

**Essays within this score range demonstrate some developing skill in responding to the task.**

The essay shows some understanding of the task. The essay takes a position on the issue but does not offer a context for discussion. The essay may acknowledge a counterargument to the writer's position, but its development is brief or unclear. Development of ideas is limited and may be repetitious, with little, if any, movement between general statements and specific reasons, examples, and details. Focus on the general topic is maintained, but focus on the specific issue in the prompt may not be maintained. The organization of the essay is simple. Ideas are logically grouped within parts of the essay, but there is little or no evidence of logical sequencing of ideas. Transitions, if used, are simple and obvious. An introduction and conclusion are clearly discernible but underdeveloped. Language shows a basic control. Sentences show a little variety and word choice is appropriate. Errors may be distracting and may occasionally impede understanding.

### **Score = 2**

**Essays within this score range demonstrate inconsistent or weak skill in responding to the task.**

The essay shows a weak understanding of the task. The essay may not take a position on the issue, or the essay may take a position but fail to convey reasons to support that position, or the essay may take a position but fail to maintain a stance. There is little or no recognition of a counterargument to the writer's position. The essay is thinly developed. If examples are given, they are general and may not be clearly relevant. The essay may include extensive repetition of the writer's ideas or of ideas in the prompt. Focus on the general topic is maintained, but focus on the specific issue in the prompt may not be maintained. There is some indication of an organizational structure, and some logical grouping of ideas within parts of the essay is apparent. Transitions, if used, are simple and obvious, and they may be inappropriate or misleading. An introduction and conclusion are discernible but minimal. Sentence structure and word choice are usually simple. Errors may be frequently distracting and may sometimes impede understanding.

### **Score = 1**

**Essays within this score range show little or no skill in responding to the task.**

The essay shows little or no understanding of the task. If the essay takes a position, it fails to convey reasons to support that position. The essay is minimally developed. The essay may include excessive repetition of the writer's ideas or of ideas in the prompt. Focus on the general topic is usually maintained, but focus on the specific issue in the prompt may not be maintained. There is little or no evidence of an organizational structure or of the logical grouping of ideas. Transitions are rarely used. If present, an introduction and conclusion are minimal. Sentence structure and word choice are simple. Errors may be frequently distracting and may significantly impede understanding.

### **No Score**

**Blank, Off-Topic, Illegible, Not in English, or Void**

## How to Score the Writing Test

Two trained readers will score each essay on the actual Writing Test. These readers are trained by reading examples of papers at each score point and by scoring many practice papers. They are given detailed feedback on the correctness of their scores during practice. During actual scoring, score differences of more than one point will be evaluated by a third trained reader to resolve discrepancies. This method is designed to be as objective and impartial as possible. So—how can you rate your *own* practice Writing Test?

It is difficult to be objective about one's own work, and you have not had the extensive training provided to actual readers of the ACT Writing Test. However, it is to your advantage to read your own writing critically. Becoming your own editor helps you grow as a writer and as a reader. So it makes sense for you to evaluate your own practice essay. It may also be helpful for you to give your practice essay to another reader to get another perspective: perhaps that of a classmate, a parent, or an English teacher, for example. Thinking and talking with others about writing is good preparation for the ACT Writing Test. To rate your essay, you and your reader(s) should read the scoring guidelines and examples, which begin below and continue through page 71, and then assign your practice essay a score of 1 through 6.

In an actual test, each essay will be scored on a scale from 1 (low) through 6 (high). The score is based on the overall impression that is created by all the elements of the writing. The scores given by the two readers are added together, yielding the Writing subscore range 2–12 shown in Table 4 on page 72.

## Scoring Guidelines (see page 66)

These are the guidelines that will be used to score your essay. These guidelines are also called a “rubric.” Many papers do not fit the exact description at each score point. You should note that the rubric says: “Papers at each level exhibit *all* or *most* of the characteristics in the descriptors.” To score your paper, read it and try to determine which score point and paragraph in the rubric best describes most of the characteristics of your essay.

Then (because your Writing Test subscore is the sum of two readers' ratings of your essay), you should multiply your 1–6 score by 2 when you use Table 4, on page 72, to find your Combined English/Writing score. Or, if both you and someone else read and score your practice essay, add those scores together.

## Comparing Your Scores

The Writing Test norms table (Table 3B on page 65) allows you to compare your score on the practice Writing Test with the scores of recent high school graduates who took the ACT Plus Writing as sophomores, juniors, or seniors. The norms for the Writing Test are reported the same way as the norms for the multiple-choice tests (see page 59). For example, a Writing subscore of 8 has a cumulative percent of 77. This means that 77% of students had a Writing subscore of 8 or lower. Remember that your scores and percents at or below are only *estimates* of the scores you will obtain on an actual administration of the ACT Plus Writing. They should be considered in connection with your performance on other essay tests and your planned college curriculum.

## College Readiness Standards

The College Readiness Standards for Writing (see page 59) can be found at [www.act.org/standard](http://www.act.org/standard).

## Example Essays and Scoring Explanations

Readers for the ACT Writing Test practice by scoring many essays before they score “live” essays. Although we cannot provide you with the same extensive training these readers receive, reading the example essays that follow will help you better understand some of the characteristics of essays at each score point. You will also be able to read a brief explanation of how each essay was scored. The example essays are in response to the practice prompt on page 58.

---

### Score = 1

The funding should be used to buy magazines. Some magazines are only for entertainment but some talk about politics and the world. Even the more popular magazine for kids will be chosen, its still the best thing to do. Students like to read about what tells them what movie stars lives are like.

### Score Point 1 Scoring Explanation

This essay shows little engagement with the prompt task. The writer does take a clear position (*The funding should be used to buy magazines*) but little is developed in support of that position. Two ideas are offered (*Some magazines are only for entertainment but some talk about politics and the world* and *Students like to read about what tells them what movie stars lives are like*). Both ideas are left unexplored and unexplained. No organization is evident. Transitions (*even, still*) are used but are unclear. No introduction or conclusion is present, unless the statement of position is considered an introduction. The essay's language is clear at the beginning, but later becomes hard to understand. Language errors and a lack of logical sequencing of ideas are also problems.



---

**Score = 2**

Popular magazines would be a good thing, it would pull students into the library and encourage them to read. Some articles in magazines have nothing to do with school, but it still encourages students to read more. Reading is education, no matter if its talking about academics or not.

Many of the subjects in the magazine are school related. If an article is about a girl from another country talking about how she lives, that's school related because it has to do with geography. If it's an article about some part of the body, then that has to do with science.

---

**Score Point 2**  
**Scoring Explanation**

Essays that earn a score of 2 demonstrate either weak or inconsistent skill in responding to the task. In this essay, the writer takes a clear position (*Popular magazines would be a good thing*) and offers specific supporting reasons (*it would pull students into the library and encourage them to read*, and *Many of the subjects in the magazine are school related*) but development of these reasons is thin. The writer does attempt to explain the second claim with examples (*If an article is about a girl from another country . . . that's . . . geography. If it's . . . the body, then . . . science*), but much more explanation is needed. The second paragraph might be understood to be responding to a counterargument from the prompt that the magazines aren't related to academic subjects. If so, it is a faint reference that should be clearer. The essay indicates organizational structure by separating the two ideas into two separate paragraphs. However, there is no discernible introduction or conclusion. Language use in the essay contains a variety of errors that distract the reader, including a run-on sentence, disagreements of subject and verb, and several misspellings.

---

**Score = 3**

I feel that schools should not subscribe to popular magazines. Sometimes the magazine articles are misleading and don't tell the truth. And some students may not know between right and wrong. I get Seventeen magazine every month. There are some subjects in the articles that I feel should not be allowed, or maybe edited. They put in college searches which are helpful, but other articles have girls talking about things that are not right. Not everybody should be reading them. Why should schools subscribe to magazines that have articles that are not right. These articles could make teenagers spend too much time thinking about things that are misleading or not right or a waist of time. Teenagers are sometimes too young to read some of the articles that the popular magazines have.

Also, popular magazines will not help students to be encouraged to read. Popular magazines have short articles that are based on opinion and gossip and they are filled with quizzes and advertisements and how to loose weight. The advertisements show skinny girls and the articles about loosing weight are not good. They are bad for teenagers to see and to read. And the other articles are a waist of time too because they are full of gossip and mostly pictures. If school libraries really want to help students, they need to subscribe to magazines that are academic, like Time and National Geographic.

There is no reason to subscribe to any other kind of popular magazines. If schools libraries did, they would find that popular magazines give students something to do instead of the research they should use the library for. It would be a perfect excuse for hanging out to just look at magazines with their friends. School libraries should not subscribe to popular magazines, especially when funding is limited.

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**Score Point 3**  
**Scoring Explanation**

Essays that earn a score of 3 show some developing skill in responding to the task. This essay takes a clear position but does not provide any context for the discussion. A counterargument taken from the prompt is vaguely referenced and refuted (*popular magazines will not help students to be encouraged to read*), but further clarification is needed to explain why short, gossipy articles are of no use in encouraging students to read. The essay contains limited movement between general statements and specific examples (*They put in college searches which are helpful, but other articles have girls talking about things that are not right.*). Focus on the specific issue in the prompt wavers because of the somewhat vague discussion the writer gives on the general, negative aspects of popular magazines (*These articles could make teenagers spend too much time thinking about things that are misleading or not right or a waist of time*). All the ideas would benefit from more development. This writer's ideas are grouped logically throughout the essay. There is only a single use of a transition (*Also*). The opening and closing sentences clearly signal an introduction and conclusion, but they lack development. The language usage in this essay demonstrates basic control. Sentences are somewhat varied in length and structure, and words are used correctly. Language errors are at times distracting.

**Score = 4**

High school libraries have only a very limited fund. The big question is how do they spend the fund. Some people think only the magazines that are about academics should be bought, but others point out that if students are interested in what is being read, they will read more, learn more and like school more. This second group is exactly right.

First, anytime someone reads, their learning. Studies show that students who read thirty minutes a day in their free time perform better than those who don't. Students are not going to want to pick up Shakespeare in their study hall, they're going to pick up "Seventeen." If you want them to get in that thirty minutes, you have to give them something they will actually open and look at. Remember it's not what we're reading, it's just the reading that counts.

Also, popular magazines can help students learn about current events. It's important to keep up with information that hasn't had time to get in the textbooks yet. Many popular magazines contain articles about new health discoveries, wars and events in other countries, and can even provide resources for research papers. This is important for our education.

Most importantly, popular magazines offer a break from the stress of schoolwork. After hours of listening to lectures and taking tests, people need to relax by reading something fun. If there is nothing fun to read, a bad attitude could develop toward libraries and school. This could hurt students much more than it would "hurt" us to read about movie stars and new music during study hall.

In conclusion, for student's mental health, knowledge, and love of reading, popular magazines should stay in our library. While some people may want to debate the issue, the right decision is clear. Interesting magazines are important for students in lots of ways.

**Score Point 4**

**Scoring Explanation**

Essays that earn a score of 4 demonstrate adequate skill in responding to the task. This essay takes a position on the issue presented in the prompt, but first offers a context for the discussion, and recognizes two different perspectives. The essay offers three ideas to support the writer's position (*anytime someone reads, their learning; popular magazines can help students learn about current events; and popular magazines offer a break*) with adequate development of each idea. The writer moves ably between general statements and some specific details (*Shakespeare/"Seventeen", health discoveries, wars, hours listening to lectures and taking tests*) and maintains focus throughout the discussion. The essay is clearly organized around a simple five-paragraph framework. The sequencing of ideas is logical, though predictable, and indicated by transitions (*First, Also, Most importantly, In conclusion*). While the transitions are simple and obvious, they are at least effective in moving the reader through the essay systematically. The introduction and conclusion are clear and somewhat developed, with the introduction offering much necessary information to set up the discussion. The conclusion makes very clear the writer's position and reasoning. Language is adequate, with a variety of sentence constructions and correct word usage. Language errors—mostly spelling—are somewhat distracting.



**Score = 5**

High school libraries have a dilemma on their hands. Should they buy popular magazines as well as academic books and publications? In a perfect world, our school library would be able to offer everything that's possible and appropriate. But with budget limits throughout the school system, the administration must be sure they're making the best choices of books and magazines, so magazines like "Teen People" and "YM" should not be paid for instead of educational books and publications.

The purpose of school, and school libraries, is learning. Supporters of popular magazines argue that there is something to be learned from any reading material, but I believe some kinds of learning are more important to students futures than other kinds. If the school library has to choose between teaching teenage girls about the achievements of Harriet Tubman and letting them read about their favorite movie star, I know which one I would vote for.

Furthermore, one of the school library's most important functions is offering students the learning resources they might not be able to find or afford on their own. Everybody would agree the school library should have Internet access for the people who don't have a computer at home. Shouldn't the library also offer full sets of encyclopedia, hard cover books and high quality magazines like "National Geographic" to students who can't buy all these materials, especially when they may only need them for one paper all year? On the other hand, anybody can spend \$3.99 at the drugstore to find out about Justin Timberlake's love life if they want to. The school library shouldn't have to finance that. If you're in study hall and you have an urgent celebrity trivia question that just can't wait, you can always use the Internet, at no extra cost to the school.

Reading for pleasure is a great thing, and one of my personal favorite leisure activities, but magazines just for entertainment shouldn't be a priority for school libraries. Learning is the reason for school, and should be first in mind as this decision is made. When funding is so limited, the school library must always put learning materials first.

**Score Point 5  
Scoring Explanation**

Essays that earn a score of 5 show a clear understanding of the task. This writer takes a position (*"Teen People" and "YM" should not be paid for instead of educational books and publications*) after establishing a broad context for discussion (*In a perfect world, our school library would be able to offer everything that's possible and appropriate. But with budget limits throughout the school system, the administration must be sure they're making the best choices*). The essay shows recognition of complexity by responding succinctly to counterarguments to the writer's position (*Supporters of popular magazines argue that there is something to be learned from any reading material, but I believe some kinds of learning are more important to students futures than other kinds*). Development of the discussion is specific, with clear movement between claims and the details that explain and support them. Development is also logical, assisted by strong, integrated transitions (*Furthermore, On the other hand*) and carefully sequenced ideas. The introduction and conclusion are both clear and generally well developed, offering necessary context and adding emphasis to clarify the argument. Language is highly competent and engaging, with a lot of sentence variety and some precise word choice (*urgent celebrity trivia question*). Language errors are minimally distracting.

**Score = 6**

High schools nowadays are struggling to draw the line between what is “educational” and what is not. School programs are cut based on how much educational content they’re perceived to have. Now the administration is trying to purge the libraries of popular magazines because they contain non academic subjects. It’s important that the library buy dictionaries and encyclopedias, but education purists need to be reminded that if you separate “academic” from “non-academic” too strictly, you separate school from the real world it’s supposed to prepare us for.

Educators are the ones who tell us we should spend more time reading. The only way to build the reading comprehension and vocabulary skills so important for getting into and through college is to practice, and that means reading things other than school assignments. No one ever gained reading proficiency from daily struggles through their Chemistry or History textbooks. We read these because we have to, but we would continue reading—even during precious homework free moments—if we had something interesting to turn to. The magazines that teenagers enjoy reading are the ones that cover our interests and address our concerns, like “Seventeen” or “Teen People”. These are the magazines that some would banish from the library.

It’s true that not every page in youth magazines is an intellectual challenge. Many pages show models selling zit cream, or contain “dream date” quizzes. But the critics of popular magazines should take a closer look at them. These same magazines have articles on suicide prevention, the spread of AIDS among teens, and college comparisons—subjects that the adult oriented news media doesn’t cover.

Even the frivolous features have something to teach the reader who wants to learn. All those “Great Looks Cheap” may be a first step toward becoming a smarter consumer. The silly quiz may open up questions about the nature of “scientific proof” or lead to more self-knowledge.

Learning is where you find it, and students may find it in places administrators and librarians might not think to look. Learning can be found in popular magazines as well as approved academic texts. There should be room in the school library for both.

**Score Point 6  
Scoring Explanation**

Essays that earn a score of 6 demonstrate effective skill in responding to the task. This writer takes a clear position, develops it throughout the essay, and states it directly in the conclusion (*Learning can be found in popular magazines as well as approved academic texts*). This position is placed in a wider context without disrupting the essay’s focus (*High schools nowadays are struggling to draw the line between what is “educational” and what is not. School programs are cut based on how much educational content they’re perceived to have*).

The essay addresses complexity by anticipating counterarguments to the writer’s position (*It’s true that not every page in youth magazines is an intellectual challenge*) and fully responding to those counterarguments by showing specifically where they are weak (*These same magazines have articles on suicide prevention, the spread of AIDS among teens, and college comparisons—subjects that the adult oriented news media doesn’t cover*).

The writer’s ideas may not be developed evenly throughout all the paragraphs, but their development is succinct and logical. The essay elaborates on general statements (*Even the frivolous features have something to teach the reader who wants to learn*) by moving to more specific details and examples (*All those “Great Looks Cheap” may be a first step toward becoming a smarter consumer*).

The organization of the essay is clear and the logical sequence of ideas grows out of the writer’s intent to persuade. Transitions help the essay flow smoothly from one paragraph to the next (*It’s true that not every page in youth magazines is an intellectual challenge.... Even the frivolous features have something to teach the reader who wants to learn*). The introduction is clear and especially well developed, connecting the writer’s position to a strong critical claim (*if you separate “academic” from “non-academic” too strictly, you separate school from the real world it’s supposed to prepare us for*).

This essay shows a good command of language. Word choice is precise and persuasive (*purge the libraries, frivolous features*). Facility with words and sentence structure enables the writer to maintain a light, amused tone (*The silly quiz may open up questions about the nature of “scientific proof” or lead to more self-knowledge*). There are few language errors in this essay, and they rarely distract the reader.

## TABLE 4

### Calculating Your Combined English/Writing Score

Complete these steps to calculate your Combined English/Writing score for your practice tests.

1. Locate your scale score for the English Test on page 63 and enter it here: \_\_\_\_\_.
2. Enter your Writing Test score (1–6) here \_\_\_\_\_ and double it to get your Writing subscore (2–12): \_\_\_\_\_  
(If two people read and scored your Writing Test, add those two scores to get your Writing subscore.)
3. Use the table below to find your Combined English/Writing score.
  - First, circle your ACT English Test score in the left column.
  - Second, circle your ACT Writing subscore at the top of the table.

- Finally, follow the English Test score row across and the Writing subscore column down until the two meet. Circle the Combined English/Writing score where the row and column meet. (For example, for an English Test score of 19 and a Writing subscore of 6, the Combined English/Writing score is 18.)

4. Using the number you circled in the table below, write your Combined English/Writing score here: \_\_\_\_\_.  
(The highest possible Combined English/Writing score is 36 and the lowest possible score is 1.)

ACT English Test score \_\_\_\_\_

Writing subscore \_\_\_\_\_

**Combined English/Writing Score** \_\_\_\_\_  
(from table below)

Combined English/Writing Scale Scores											
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You may wish to remove this sample answer document from the booklet to use in a practice test session for the four multiple-choice tests.

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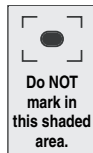
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## The ACT® PLUS WRITING 2008-2009 Answer Folder

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**USE A SOFT LEAD NO. 2 PENCIL ONLY.**  
(Do NOT use a mechanical pencil, ink, ballpoint, correction fluid, or felt-tip pen.)

**EXAMINEE STATEMENT AND SIGNATURE:** After testing, the test administrator will instruct you to complete this section. Read the statement below.

**Statement:** I agree to the conditions set forth in the ACT registration booklet or website instructions for this exam, including the arbitration and dispute remedy provisions. I understand that I cannot share any test questions, responses, or essay topics with anyone by any form of communication.

Now, copy only the certification below on the lines provided in cursive (do not print) and sign your name as you would any official document. If you cannot copy the certification in cursive, your test administrator will give you instructions.

**Certification:** I agree to the statement above and certify that I am the person whose name and address appear on this form.

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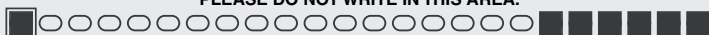


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Your Signature

Today's Date

PLEASE DO NOT WRITE IN THIS AREA.

**SERIAL #**

PAGE 2

**Marking Directions:** Mark only **one** oval for each question. Fill in response completely. Erase errors cleanly without smudging.

**Correct mark:** ☐ ☒ ☐ ☐

**Do NOT use these incorrect or bad marks.**

Incorrect marks: ☒ ☒ ☒  
 Overlapping mark: ☐ ☐ ☐  
 Cross-out mark: ☐ ☐ ☐  
 Smudged erasure: ☐ ☐ ☐  
 Mark is too light: ☐ ☐ ☐

**BOOKLET NUMBER**

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**FORM**

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Print your 3-character **Test Form** in the boxes above and fill in the corresponding oval at the right.

**BE SURE TO FILL IN THE CORRECT FORM OVAL.**

☐ 0661C

**TEST 1**

1 (A B C D)	14 (F G H J)	27 (A B C D)	40 (F G H J)	53 (A B C D)	66 (F G H J)
2 (F G H J)	15 (A B C D)	28 (F G H J)	41 (A B C D)	54 (F G H J)	67 (A B C D)
3 (A B C D)	16 (F G H J)	29 (A B C D)	42 (F G H J)	55 (A B C D)	68 (F G H J)
4 (F G H J)	17 (A B C D)	30 (F G H J)	43 (A B C D)	56 (F G H J)	69 (A B C D)
5 (A B C D)	18 (F G H J)	31 (A B C D)	44 (F G H J)	57 (A B C D)	70 (F G H J)
6 (F G H J)	19 (A B C D)	32 (F G H J)	45 (A B C D)	58 (F G H J)	71 (A B C D)
7 (A B C D)	20 (F G H J)	33 (A B C D)	46 (F G H J)	59 (A B C D)	72 (F G H J)
8 (F G H J)	21 (A B C D)	34 (F G H J)	47 (A B C D)	60 (F G H J)	73 (A B C D)
9 (A B C D)	22 (F G H J)	35 (A B C D)	48 (F G H J)	61 (A B C D)	74 (F G H J)
10 (F G H J)	23 (A B C D)	36 (F G H J)	49 (A B C D)	62 (F G H J)	75 (A B C D)
11 (A B C D)	24 (F G H J)	37 (A B C D)	50 (F G H J)	63 (A B C D)	
12 (F G H J)	25 (A B C D)	38 (F G H J)	51 (A B C D)	64 (F G H J)	
13 (A B C D)	26 (F G H J)	39 (A B C D)	52 (F G H J)	65 (A B C D)	

**TEST 2**

1 (A B C D E)	11 (A B C D E)	21 (A B C D E)	31 (A B C D E)	41 (A B C D E)	51 (A B C D E)
2 (F G H J K)	12 (F G H J K)	22 (F G H J K)	32 (F G H J K)	42 (F G H J K)	52 (F G H J K)
3 (A B C D E)	13 (A B C D E)	23 (A B C D E)	33 (A B C D E)	43 (A B C D E)	53 (A B C D E)
4 (F G H J K)	14 (F G H J K)	24 (F G H J K)	34 (F G H J K)	44 (F G H J K)	54 (F G H J K)
5 (A B C D E)	15 (A B C D E)	25 (A B C D E)	35 (A B C D E)	45 (A B C D E)	55 (A B C D E)
6 (F G H J K)	16 (F G H J K)	26 (F G H J K)	36 (F G H J K)	46 (F G H J K)	56 (F G H J K)
7 (A B C D E)	17 (A B C D E)	27 (A B C D E)	37 (A B C D E)	47 (A B C D E)	57 (A B C D E)
8 (F G H J K)	18 (F G H J K)	28 (F G H J K)	38 (F G H J K)	48 (F G H J K)	58 (F G H J K)
9 (A B C D E)	19 (A B C D E)	29 (A B C D E)	39 (A B C D E)	49 (A B C D E)	59 (A B C D E)
10 (F G H J K)	20 (F G H J K)	30 (F G H J K)	40 (F G H J K)	50 (F G H J K)	60 (F G H J K)

**TEST 3**

1 (A B C D)	8 (F G H J)	15 (A B C D)	22 (F G H J)	29 (A B C D)	36 (F G H J)
2 (F G H J)	9 (A B C D)	16 (F G H J)	23 (A B C D)	30 (F G H J)	37 (A B C D)
3 (A B C D)	10 (F G H J)	17 (A B C D)	24 (F G H J)	31 (A B C D)	38 (F G H J)
4 (F G H J)	11 (A B C D)	18 (F G H J)	25 (A B C D)	32 (F G H J)	39 (A B C D)
5 (A B C D)	12 (F G H J)	19 (A B C D)	26 (F G H J)	33 (A B C D)	40 (F G H J)
6 (F G H J)	13 (A B C D)	20 (F G H J)	27 (A B C D)	34 (F G H J)	
7 (A B C D)	14 (F G H J)	21 (A B C D)	28 (F G H J)	35 (A B C D)	

**TEST 4**

1 (A B C D)	8 (F G H J)	15 (A B C D)	22 (F G H J)	29 (A B C D)	36 (F G H J)
2 (F G H J)	9 (A B C D)	16 (F G H J)	23 (A B C D)	30 (F G H J)	37 (A B C D)
3 (A B C D)	10 (F G H J)	17 (A B C D)	24 (F G H J)	31 (A B C D)	38 (F G H J)
4 (F G H J)	11 (A B C D)	18 (F G H J)	25 (A B C D)	32 (F G H J)	39 (A B C D)
5 (A B C D)	12 (F G H J)	19 (A B C D)	26 (F G H J)	33 (A B C D)	40 (F G H J)
6 (F G H J)	13 (A B C D)	20 (F G H J)	27 (A B C D)	34 (F G H J)	
7 (A B C D)	14 (F G H J)	21 (A B C D)	28 (F G H J)	35 (A B C D)	

**ACT STUDENT REVIEW:** The test administrator will give you instructions for completing this section.



**Student Review:** Your responses to these items will assist ACT and your test center in providing the best possible conditions for testing and planning for the future. Fill in the oval indicating your response to each item printed on the back of your test booklet.

Yes	No	Yes	No	Yes	No
1 <input type="radio"/>	<input type="radio"/>	6 <input type="radio"/>	<input type="radio"/>	11 <input type="radio"/>	<input type="radio"/>
2 <input type="radio"/>	<input type="radio"/>	7 <input type="radio"/>	<input type="radio"/>	12 <input type="radio"/>	<input type="radio"/>
3 <input type="radio"/>	<input type="radio"/>	8 <input type="radio"/>	<input type="radio"/>	13 <input type="radio"/>	<input type="radio"/>
4 <input type="radio"/>	<input type="radio"/>	9 <input type="radio"/>	<input type="radio"/>	14 <input type="radio"/>	<input type="radio"/>
5 <input type="radio"/>	<input type="radio"/>	10 <input type="radio"/>	<input type="radio"/>	15 <input type="radio"/>	<input type="radio"/>

Cut Here



75



## WRITING TEST

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

2

**If you need more space, please continue on the back of this page.**

**Do not write in this shaded area.**

Cut Here

WRITING TEST

Handwriting practice lines for the writing test.

3

If you need more space, please continue on the next page.

PLEASE DO NOT WRITE IN THIS AREA.

SERIAL #



## WRITING TEST

4

**STOP** here with the Writing Test.

**Do not write in this shaded area.**



# Improve Your Test Scores with Strategy, Practice, and Insight

## ACT *Online Prep*<sup>TM</sup>

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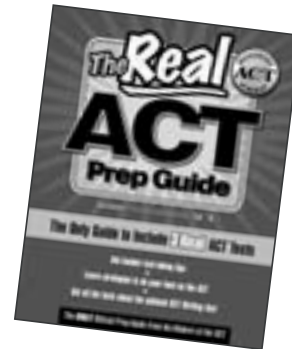
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# **EXHIBIT E**



# Official SAT<sup>®</sup> Practice Test 2007-08

## Taking the Practice Test

The practice test will help you most if you take it under conditions as close as possible to those of the actual test.

- **Set aside 3 hours and 20 minutes of uninterrupted time**

That way you can complete the entire test in one sitting. *Note:* The total testing time is 3 hours and 45 minutes, but you save 25 minutes because the unscored section\* from this practice test was omitted.

- **Sit at a desk or table cleared of any other papers or books**

You won't be able to take a dictionary, books, notes, or scratch paper into the test room.

- **Allow yourself the specified amount of time for each section**

Pace yourself by using a watch (without an audible alarm), which is what you are allowed to use on test day.

- **Have a calculator at hand when you take the math sections**

This will help you determine how much to use a calculator the day of the test. Use a calculator with which you are familiar—preferably the same calculator you will use on test day.

- **Read the test instructions carefully**

They are reprinted from the back cover of the test book. On test day, you will be asked to read them before you begin answering questions.

- **Make sure you use a No. 2 pencil**

It is very important that you fill in the entire circle on the answer sheet darkly and completely. If you change your response, erase it as completely as possible. It is very important that you follow these instructions when filling out your answer sheet.

- **Record your answers on paper, then score your test**

Use the answer sheet when completing a practice test on paper to simulate the real testing environment. After completing the practice test, you can score the test yourself with "Scoring Your Test," or you can return to [collegeboard.com](http://collegeboard.com) to enter your answers online and receive a score report and answer explanations.

\*Section 4 is an unscored section and has been omitted on this test because it contains questions that may be used in future editions of the SAT<sup>®</sup>.

YOUR NAME (PRINT) \_\_\_\_\_ LAST \_\_\_\_\_ FIRST \_\_\_\_\_ MI \_\_\_\_\_

TEST CENTER \_\_\_\_\_ NUMBER \_\_\_\_\_ NAME OF TEST CENTER \_\_\_\_\_ ROOM NUMBER \_\_\_\_\_






## SAT Reasoning Test — General Directions

### Timing

- You will have 3 hours and 45 minutes to work on this test.
- There are ten separately timed sections:
  - One 25-minute essay
  - Six other 25-minute sections
  - Two 20-minute sections
  - One 10-minute section
- You may work on only one section at a time.
- The supervisor will tell you when to begin and end each section.
- If you finish a section before time is called, check your work on that section. You may NOT turn to any other section.
- Work as rapidly as you can without losing accuracy. Don't waste time on questions that seem too difficult for you.

### Marking Answers

- Be sure to mark your answer sheet properly.

COMPLETE MARK  EXAMPLES OF INCOMPLETE MARKS    

- You must use a No. 2 pencil.
- Carefully mark only one answer for each question.
- Make sure you fill the entire circle darkly and completely.
- Do not make any stray marks on your answer sheet.
- If you erase, do so completely. Incomplete erasures may be scored as intended answers.
- Use only the answer spaces that correspond to the question numbers.

### Using Your Test Book

- You may use the test book for scratchwork, but you will not receive credit for anything written there.
- After time has been called, you may not transfer answers to your answer sheet or fill in circles.
- You may not fold or remove pages or portions of a page from this book, or take the book or answer sheet from the testing room.

### Scoring

- For each correct answer, you receive one point.
- For questions you omit, you receive no points.
- For a wrong answer to a multiple-choice question, you lose one-fourth of a point.
  - If you can eliminate one or more of the answer choices as wrong, you increase your chances of choosing the correct answer and earning one point.
  - If you can't eliminate any choice, move on. You can return to the question later if there is time.
- For a wrong answer to a student-produced response ("grid-in") math question, you don't lose any points.
- Multiple-choice and student-produced response questions are machine scored.
- The essay is scored on a 1 to 6 scale by two different readers. The total essay score is the sum of the two readers' scores.
- Off-topic essays, blank essays, and essays written in ink will receive a score of zero.
- If your essay does not reflect your original and individual work, your test scores may be canceled.

The passages for this test have been adapted from published material.  
The ideas contained in them do not necessarily represent the opinions of the College Board.

**IMPORTANT:** The codes below are unique to your test book. Copy them on your answer sheet in boxes 8 and 9 and fill in the corresponding circles exactly as shown.

9	TEST FORM						
	(Copy from back of test book.)						
	0	6	1	3	5	1	4

8	FORM CODE						
	(Copy and grid as on back of test book.)						
	G	M	C	M	5	1	4
A	A	A	A	0	0	0	
B	B	B	B	1	1	1	
C	C	C	C	2	2	2	
D	D	D	D	3	3	3	
E	E	E	E	4	4	4	
F	F	F	F	5	5	5	
G	G	G	G	6	6	6	
H	H	H	H	7	7	7	
I	I	I	I	8	8	8	
J	J	J	J	9	9	9	
K	K	K	K				
L	L	L	L				
M	M	M	M				
N	N	N	N				
O	O	O	O				
P	P	P	P				
Q	Q	Q	Q				
R	R	R	R				
S	S	S	S				
T	T	T	T				
U	U	U	U				
V	V	V	V				
W	W	W	W				
X	X	X	X				
Y	Y	Y	Y				
Z	Z	Z	Z				

**DO NOT OPEN THIS BOOK UNTIL THE SUPERVISOR TELLS YOU TO DO SO.**



# 1

- [illegible]



837

This image shows a single sheet of white paper with horizontal blue ruling lines. The lines are evenly spaced and run across the width of the page. There is a faint red vertical margin line on the left side. At the top center, there is a small red mark that appears to be the number "83".



4

31	(A)	(B)	(C)	(D)	(E)
32	(A)	(B)	(C)	(D)	(E)
33	(A)	(B)	(C)	(D)	(E)
34	(A)	(B)	(C)	(D)	(E)
35	(A)	(B)	(C)	(D)	(E)
36	(A)	(B)	(C)	(D)	(E)
37	(A)	(B)	(C)	(D)	(E)
38	(A)	(B)	(C)	(D)	(E)
39	(A)	(B)	(C)	(D)	(E)
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SERIAL #

COMPLETE MARK



EXAMPLES OF  
INCOMPLETE MARKS



You must use a No. 2 pencil and marks must be complete. Do not use a mechanical pencil. It is very important that you fill in the entire circle darkly and completely. If you change your response, erase as completely as possible. Incomplete marks or erasures may affect your score.

SECTION

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Quality



Assurance  
Mark

SECTION

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## CERTIFICATION STATEMENT

Copy the statement below (do not print) and sign your name as you would an official document.

I hereby agree to the conditions set forth online at [www.collegeboard.com](http://www.collegeboard.com) and/or in the SAT<sup>®</sup> Registration Booklet and certify that I am the person whose name and address appear on this answer sheet.

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By signing below, I agree not to share any specific test questions or essay topics with anyone by any form of communication, including, but not limited to: email, text messages, or use of the Internet.

Signature \_\_\_\_\_

Date \_\_\_\_\_

## SPECIAL QUESTIONS

- 1 (A) (B) (C) (D) (E) (F) (G) (H) (I) (J)  
2 (A) (B) (C) (D) (E) (F) (G) (H) (I) (J)  
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# ESSAY

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# ESSAY



## ESSAY

Time — 25 minutes

**Turn to page 2 of your answer sheet to write your ESSAY.**

The essay gives you an opportunity to show how effectively you can develop and express ideas. You should, therefore, take care to develop your point of view, present your ideas logically and clearly, and use language precisely.

Your essay must be written on the lines provided on your answer sheet—you will receive no other paper on which to write. You will have enough space if you write on every line, avoid wide margins, and keep your handwriting to a reasonable size. Remember that people who are not familiar with your handwriting will read what you write. Try to write or print so that what you are writing is legible to those readers.

### Important Reminders:

- **A pencil is required for the essay.** An essay written in ink will receive a score of zero.
- **Do not write your essay in your test book.** You will receive credit only for what you write on your answer sheet.
- **An off-topic essay will receive a score of zero.**
- **If your essay does not reflect your original and individual work, your test scores may be canceled.**

You have twenty-five minutes to write an essay on the topic assigned below.

Think carefully about the issue presented in the following excerpt and the assignment below.

Given the importance of human creativity, one would think it should have a high priority among our concerns. But if we look at the reality, we see a different picture. Basic scientific research is minimized in favor of immediate practical applications. The arts are increasingly seen as dispensable luxuries. Yet as competition heats up around the globe, exactly the opposite strategy is needed.

Adapted from Mihaly Csikszentmihalyi, *Creativity: Flow and the Psychology of Discovery and Invention*

**Assignment:** Is creativity needed more than ever in the world today? Plan and write an essay in which you develop your point of view on this issue. Support your position with reasoning and examples taken from your reading, studies, experience, or observations.

BEGIN WRITING YOUR ESSAY ON PAGE 2 OF THE ANSWER SHEET.

**If you finish before time is called, you may check your work on this section only.**

**Do not turn to any other section in the test.**

2

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2

## SECTION 2

Time — 25 minutes

18 Questions

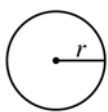
Turn to Section 2 (page 4) of your answer sheet to answer the questions in this section.

**Directions:** This section contains two types of questions. You have 25 minutes to complete both types. For questions 1-8, solve each problem and decide which is the best of the choices given. Fill in the corresponding circle on the answer sheet. You may use any available space for scratchwork.

Notes

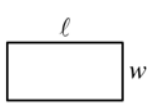
1. The use of a calculator is permitted.
2. All numbers used are real numbers.
3. Figures that accompany problems in this test are intended to provide information useful in solving the problems. They are drawn as accurately as possible EXCEPT when it is stated in a specific problem that the figure is not drawn to scale. All figures lie in a plane unless otherwise indicated.
4. Unless otherwise specified, the domain of any function  $f$  is assumed to be the set of all real numbers  $x$  for which  $f(x)$  is a real number.

Reference Information



$$A = \pi r^2$$

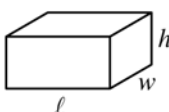
$$C = 2\pi r$$



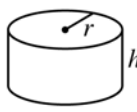
$$A = \ell w$$



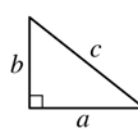
$$A = \frac{1}{2}bh$$



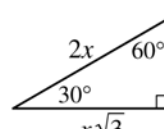
$$V = \ell wh$$



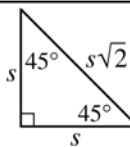
$$V = \pi r^2 h$$



$$c^2 = a^2 + b^2$$



Special Right Triangles

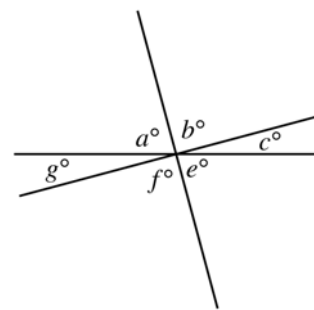


The number of degrees of arc in a circle is 360.

The sum of the measures in degrees of the angles of a triangle is 180.

1. If  $4(t + u) + 3 = 19$ , then  $t + u =$

- (A) 3  
(B) 4  
(C) 5  
(D) 6  
(E) 7



Note: Figure not drawn to scale.

2. In the figure above, three lines intersect at a point. If  $f = 85$  and  $c = 25$ , what is the value of  $a$ ?

- (A) 60  
(B) 65  
(C) 70  
(D) 75  
(E) 85

GO ON TO THE NEXT PAGE



2

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2

3. If Marisa drove  $n$  miles in  $t$  hours, which of the following represents her average speed, in miles per hour?

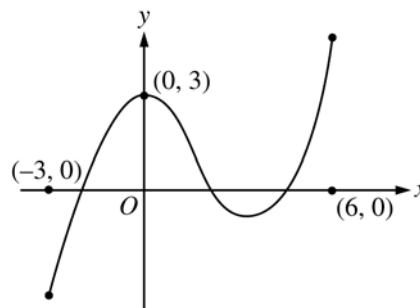
- (A)  $\frac{n}{t}$   
 (B)  $\frac{t}{n}$   
 (C)  $\frac{1}{nt}$   
 (D)  $nt$   
 (E)  $n^2t$

4. If  $a$  is an odd integer and  $b$  is an even integer, which of the following is an odd integer?

- (A)  $3b$   
 (B)  $a + 3$   
 (C)  $2(a + b)$   
 (D)  $a + 2b$   
 (E)  $2a + b$

5. In the coordinate plane, the points  $F(-2, 1)$ ,  $G(1, 4)$ , and  $H(4, 1)$  lie on a circle with center  $P$ . What are the coordinates of point  $P$ ?

- (A)  $(0, 0)$   
 (B)  $(1, 1)$   
 (C)  $(1, 2)$   
 (D)  $(1, -2)$   
 (E)  $(2.5, 2.5)$



6. The graph of  $y = f(x)$  is shown above. If  $-3 \leq x \leq 6$ , for how many values of  $x$  does  $f(x) = 2$ ?

- (A) None  
 (B) One  
 (C) Two  
 (D) Three  
 (E) More than three

7. If the average (arithmetic mean) of  $t$  and  $t + 2$  is  $x$  and if the average of  $t$  and  $t - 2$  is  $y$ , what is the average of  $x$  and  $y$ ?

- (A) 1  
 (B)  $\frac{t}{2}$   
 (C)  $t$   
 (D)  $t + \frac{1}{2}$   
 (E)  $2t$

8. For all numbers  $x$  and  $y$ , let  $x \triangle y$  be defined as  $x \triangle y = x^2 + xy + y^2$ . What is the value of  $(3 \triangle 1) \triangle 1$ ?

- (A) 5  
 (B) 13  
 (C) 27  
 (D) 170  
 (E) 183

GO ON TO THE NEXT PAGE 

2

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2

**Directions:** For Student-Produced Response questions 9-18, use the grids at the bottom of the answer sheet page on which you have answered questions 1-8.

Each of the remaining 10 questions requires you to solve the problem and enter your answer by marking the circles in the special grid, as shown in the examples below. You may use any available space for scratchwork.

Answer:  $\frac{7}{12}$

Write answer in boxes. →

7	/	1	2
•	•	•	•
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

← Fraction line

Grid in result. →

Answer: 2.5

2	.	5
•	•	•
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9

← Decimal point

Answer: 201

Either position is correct.

2	0	1
•	•	•
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4

2	0	1
•	•	•
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4

**Note:** You may start your answers in any column, space permitting. Columns not needed should be left blank.

- Mark no more than one circle in any column.
- Because the answer sheet will be machine-scored, **you will receive credit only if the circles are filled in correctly.**
- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- No question has a negative answer.
- **Mixed numbers** such as  $3\frac{1}{2}$  must be gridded as

3.5 or  $7/2$ . (If  $\frac{31}{2}$  is gridded, it will be interpreted as  $\frac{31}{2}$ , not  $3\frac{1}{2}$ .)

- **Decimal Answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid. For example, if you obtain an answer such as 0.6666..., you should record your result as .666 or .667. **A less accurate value such as .66 or .67 will be scored as incorrect.**

Acceptable ways to grid  $\frac{2}{3}$  are:

2	/	3
•	•	•
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6

.	6	6	6
•	•	•	•
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6

.	6	6	7
•	•	•	•
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6

9. Morgan's plant grew from 42 centimeters to 57 centimeters in a year. Linda's plant, which was 59 centimeters at the beginning of the year, grew twice as many centimeters as Morgan's plant did during the same year. How tall, in centimeters, was Linda's plant at the end of the year?

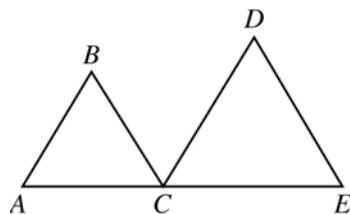
10. Since the beginning of 1990, the number of squirrels in a certain wooded area has tripled during every 3-year period of time. If there were 5,400 squirrels in the wooded area at the beginning of 1999, how many squirrels were in the wooded area at the beginning of 1990?

GO ON TO THE NEXT PAGE

2

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2



11. In the figure above, triangles  $ABC$  and  $CDE$  are equilateral and line segment  $\overline{AE}$  has length 25. What is the sum of the perimeters of the two triangles?

12. Marbles are to be removed from a jar that contains 12 red marbles and 12 black marbles. What is the least number of marbles that could be removed so that the ratio of red marbles to black marbles left in the jar will be 4 to 3?

$$\begin{aligned}x &= 3v \\v &= 4t \\x &= pt\end{aligned}$$

13. For the system of equations above, if  $x \neq 0$ , what is the value of  $p$ ?

14. If  $|-2x + 1| < 1$ , what is one possible value of  $x$ ?

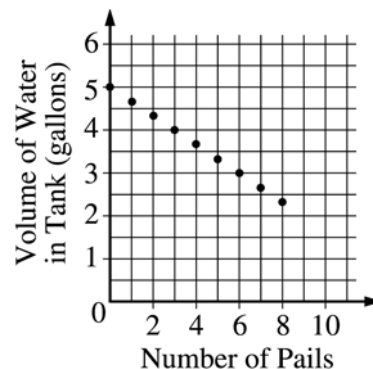
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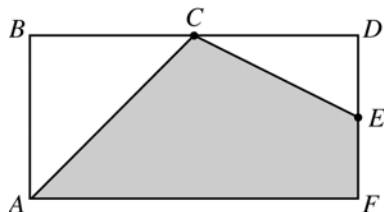
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2

15. For what positive number is the square root of the number the same as the number divided by 40?



17. The graph above shows the amount of water remaining in a tank each time a pail was used to remove  $x$  gallons of water. If 5 gallons were in the tank originally and  $2\frac{1}{3}$  gallons remained after the last pail containing  $x$  gallons was removed, what is the value of  $x$ ?



16. In rectangle  $ABDF$  above,  $C$  and  $E$  are midpoints of sides  $\overline{BD}$  and  $\overline{DF}$ , respectively. What fraction of the area of the rectangle is shaded?

18. If  $0 \leq x \leq y$  and  $(x + y)^2 - (x - y)^2 \geq 25$ , what is the least possible value of  $y$ ?

# STOP

If you finish before time is called, you may check your work on this section only.  
Do not turn to any other section in the test.

3



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3

## SECTION 3

Time — 25 minutes

35 Questions

**Turn to Section 3 (page 4) of your answer sheet to answer the questions in this section.**

**Directions:** For each question in this section, select the best answer from among the choices given and fill in the corresponding circle on the answer sheet.

The following sentences test correctness and effectiveness of expression. Part of each sentence or the entire sentence is underlined; beneath each sentence are five ways of phrasing the underlined material. Choice A repeats the original phrasing; the other four choices are different. If you think the original phrasing produces a better sentence than any of the alternatives, select choice A; if not, select one of the other choices.

In making your selection, follow the requirements of standard written English; that is, pay attention to grammar, choice of words, sentence construction, and punctuation. Your selection should result in the most effective sentence—clear and precise, without awkwardness or ambiguity.

## EXAMPLE:

Laura Ingalls Wilder published her first book and she was sixty-five years old then.

- (A) and she was sixty-five years old then
- (B) when she was sixty-five
- (C) at age sixty-five years old
- (D) upon the reaching of sixty-five years
- (E) at the time when she was sixty-five

(A) ● (C) (D) (E)

1. The poet Claude McKay was a native of Jamaica who spent most of his life in the United States but writing some of his poems in the Jamaican dialect.
  - (A) The poet Claude McKay was a native of Jamaica who spent most of his life in the United States but writing
  - (B) Being that he was a Jamaican who spent most of his life in the United States, the poet Claude McKay writing
  - (C) Although a native of Jamaica, the poet Claude McKay spent most of his life in the United States, he wrote
  - (D) Although the poet Claude McKay spent most of his life in the United States, he was a native of Jamaica and wrote
  - (E) Because he was a native of Jamaica who spent most of his life in the United States, the poet Claude McKay writing
2. Many ancient Eastern rulers favored drinking vessels made of celadon porcelain because of supposedly revealing the presence of poison by cracking.
  - (A) because of supposedly revealing the presence of poison
  - (B) for being supposed that it would reveal the presence of poison
  - (C) because of being supposed to reveal poison in it
  - (D) for it was supposed to reveal that there is poison
  - (E) because it was supposed to reveal the presence of poison
3. John believes that plants respond to human attention, which causes his talking to his African violets every night.
  - (A) attention, which causes his talking
  - (B) attention and talking is what is done
  - (C) attention and his talks
  - (D) attention; for this reason has been his talking
  - (E) attention; he therefore talks
4. All the demands on soprano Kathleen Battle for operatic performances, solo concerts, and special guest appearances, tempting her to sing too often and straining her voice.
  - (A) appearances, tempting her to sing too often and straining
  - (B) appearances not only tempt her to sing too often plus they strain
  - (C) appearances tempts her not only into singing too often but then she strains
  - (D) appearances, tempting her into singing too often and she therefore strains
  - (E) appearances tempt her to sing too often and strain

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5. One reason that an insect can walk on walls while a human cannot is that the mass of its tiny body is far lower than humans.
- (A) far lower than humans  
(B) far lower than that of a human's body  
(C) lower by far than humans  
(D) far lower than a human  
(E) far lower than is a human's body
6. In the 1980's, the median price of a house more than doubled, generally outdistancing the rate of inflation.
- (A) generally outdistancing the rate of inflation  
(B) generally this outdistanced the rate of inflation  
(C) and the result was the general outdistancing of inflation  
(D) the general rate of inflation was thus outdistanced  
(E) thus generally inflation had been outdistanced
7. In the nineteenth century, reproductions of cathedrals or castles made entirely of ice was often a popular feature in North American winter carnivals.
- (A) was often a popular feature  
(B) often were popular features  
(C) often was featured popularly  
(D) often being popular features  
(E) have been featured popularly
8. A fine orchestral performance will exhibit the skills of the musicians, their abilities to work as an ensemble, and how he or she responds to the conductor.
- (A) how he or she responds  
(B) how to respond  
(C) their responding  
(D) their responses  
(E) they respond
9. The African tsetse fly does not need a brain, everything it has to do in life is programmed into its nervous system.
- (A) brain, everything  
(B) brain due to everything which  
(C) brain, for everything  
(D) brain; since, everything  
(E) brain whereas everything
10. She was concerned about how Hank would react to the incident, but in searching his face, he did not seem to be at all embarrassed or troubled.
- (A) in searching his face, he did not seem to be  
(B) by searching his face, it showed that he was not  
(C) a search of his face showed that he seemed not  
(D) searching his face, he did not seem to be  
(E) his face being searched showed that he was not
11. Explaining modern art is impossible, partly because of its complexity but largely because of it rapidly changing.
- (A) of it rapidly changing  
(B) it makes rapid changes  
(C) of the rapidity with which it changes  
(D) changing it is rapid  
(E) it changes so rapid

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The following sentences test your ability to recognize grammar and usage errors. Each sentence contains either a single error or no error at all. No sentence contains more than one error. The error, if there is one, is underlined and lettered. If the sentence contains an error, select the one underlined part that must be changed to make the sentence correct. If the sentence is correct, select choice E. In choosing answers, follow the requirements of standard written English.

EXAMPLE:

The other delegates and him immediately  
A B C  
accepted the resolution drafted by the  
D  
neutral states. No error  
E

(A) (B) (C) (D) (E)

12. The ambassador was entertained lavish by  
A  
Hartwright, whose company has a monetary  
B C  
interest in the industrial development of the  
D  
new country. No error  
E
13. Among the discoveries made possible by  
A B  
the invention of the telescope they found that  
C D  
dark spots existed on the Sun in varying numbers.  
No error  
E
14. This liberal arts college has decided requiring  
A B  
all students to study at least one non-European  
C D  
language. No error  
E

15. Twenty-five years after Alex Haley's *Roots* stimulate  
A B  
many people to research their family histories, new  
C  
technology has been developed to make the task  
easier . No error  
D E
16. For months the press had praised Thatcher's handling  
of the international crisis, and editorial views changed  
A  
quickly when the domestic economy worsened .  
B C D  
No error  
E
17. Experiments have shown that human skin provides  
A B  
natural protection against a surprising large  
C  
number of infectious bacteria. No error  
D E
18. In the aggressive society created by William Golding  
A  
in *Lord of the Flies*, both Ralph and Jack emerge  
early on as the leader of the lost boys. No error  
B C D E
19. More than forty years have passed since a quarter  
A B  
of a million people marched on Washington, D.C.,  
in an attempt to secure civil rights for Black  
C D  
Americans. No error  
E

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**Directions:** The following passage is an early draft of an essay. Some parts of the passage need to be rewritten.

Read the passage and select the best answers for the questions that follow. Some questions are about particular sentences or parts of sentences and ask you to improve sentence structure or word choice. Other questions ask you to consider organization and development. In choosing answers, follow the requirements of standard written English.

**Questions 30-35 are based on the following passage.**

(1) My father has an exceptional talent. (2) The ability to understand people. (3) When I have a problem that I think no one else will understand, I take it to my father. (4) He listens intently, asks me some questions, and my feelings are seemingly known by him exactly. (5) Even my twin sister can talk to him more easily than to me. (6) Many people seem too busy to take the time to understand one another. (7) My father, by all accounts, sees taking time to listen as essential to any relationship, whether it involves family, friendship, or work.

(8) At work, my father's friends and work associates benefit from this talent. (9) His job requires him to attend social events and sometimes I go along. (10) I have watched him at dinner; his eyes are fixed on whoever is speaking, and he nods his head at every remark. (11) My father emerges from such a conversation with what I believe is a true sense of the speaker's meaning. (12) In the same way, we choose our friends.

(13) My father's ability to listen affects his whole life. (14) His ability allows him to form strong relationships with his coworkers and earns him lasting friendships. (15) It allows him to have open conversations with his children. (16) Furthermore, it has strengthened his relationship with my mother. (17) Certainly, his talent is one that I hope to develop as I mature.

30. Of the following, which is the best way to revise and combine sentences 1 and 2 (reproduced below) ?

*My father has an exceptional talent. The ability to understand people.*

- (A) My father has an exceptional talent and the ability to understand people.
- (B) My father has an exceptional talent that includes the ability to understand people.
- (C) My father has an exceptional talent: the ability to understand people.
- (D) My father has an exceptional talent, it is his ability to understand people.
- (E) Despite my father's exceptional talent, he still has the ability to understand people.

31. Of the following, which is the best way to phrase sentence 4 (reproduced below) ?

*He listens intently, asks me some questions, and my feelings are seemingly known by him exactly.*

- (A) (As it is now)
- (B) Listening intently, he will ask me some questions and then my exact feelings are seemingly known to him.
- (C) As he listens to me and asks me some questions, he seems to be knowing exactly my feelings.
- (D) He listened to me and asked me some questions, seeming to know exactly how I felt.
- (E) He listens intently, asks me some questions, and then seems to know exactly how I feel.

32. In sentence 7, the phrase *by all accounts* is best replaced by

- (A) however
- (B) moreover
- (C) to my knowledge
- (D) like my sister
- (E) but nevertheless

33. Which of the following sentences should be omitted to improve the unity of the second paragraph?

- (A) Sentence 8
- (B) Sentence 9
- (C) Sentence 10
- (D) Sentence 11
- (E) Sentence 12

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34. In context, which of the following is the best way to phrase the underlined portion of sentence 16 (reproduced below) ?

*Furthermore, it has strengthened his relationship with my mother.*

- (A) (As it is now)
- (B) Further strengthening
- (C) But it strengthens
- (D) However, he is strengthening
- (E) Considering this, he strengthens

35. A strategy that the writer uses within the third paragraph is to

- (A) make false assumptions and use exaggeration
- (B) include difficult vocabulary
- (C) repeat certain words and sentence patterns
- (D) argue in a tone of defiance
- (E) turn aside from the main subject

**S T O P**

If you finish before time is called, you may check your work on this section only.  
Do not turn to any other section in the test.



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## SECTION 4

Time — 25 minutes

23 Questions

**Turn to Section 4 (page 5) of your answer sheet to answer the questions in this section.**

**Directions:** For each question in this section, select the best answer from among the choices given and fill in the corresponding circle on the answer sheet.

Each sentence below has one or two blanks, each blank indicating that something has been omitted. Beneath the sentence are five words or sets of words labeled A through E. Choose the word or set of words that, when inserted in the sentence, best fits the meaning of the sentence as a whole.

**Example:**

Hoping to ----- the dispute, negotiators proposed a compromise that they felt would be ----- to both labor and management.

- (A) enforce . . useful
- (B) end . . divisive
- (C) overcome . . unattractive
- (D) extend . . satisfactory
- (E) resolve . . acceptable

(A) (B) (C) (D) ●

1. Scientific discoveries are often thought of as the result of ----- effort, but many discoveries have, in fact, arisen from ----- or a mistake.

- (A) conscientious . . a method
- (B) incidental . . a mishap
- (C) collaborative . . a design
- (D) persistent . . an extension
- (E) systematic . . an accident

2. Nations that share a border are, by definition, -----.

- (A) allied (B) partisan (C) contiguous
- (D) pluralistic (E) sovereign

3. Much of this author's work, unfortunately, is -----, with ----- chapter often immediately following a sublime one.

- (A) mystical . . a superior
- (B) uneven . . a mediocre
- (C) predictable . . an eloquent
- (D) enthralling . . a vapid
- (E) flippant . . an intelligible

4. In young children, some brain cells have a ----- that enables them to take over the functions of damaged or missing brain cells.

- (A) fragility (B) reminiscence
- (C) perniciousness (D) whimsicality
- (E) plasticity

5. "Less government spending" is ----- of this political party, a belief shared by most party members.

- (A) an acronym (B) a retraction (C) a tenet
- (D) a plight (E) a prospectus

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The passages below are followed by questions based on their content; questions following a pair of related passages may also be based on the relationship between the paired passages. Answer the questions on the basis of what is stated or implied in the passages and in any introductory material that may be provided.

**Questions 6-7 are based on the following passage.**

Line Duke Ellington considered himself “the world’s greatest  
5 listener.” In music, hearing is all. Judging by the two or  
three thousand pieces of music Ellington wrote, he could  
probably hear a flea scratching itself and put that rhythm  
10 into one of his compositions. For him the sounds of the  
world were the ingredients he mixed into appetizers,  
main courses, and desserts to satisfy the appetite of his  
worldwide audience. He wasn’t averse to going out in  
a boat to catch the fish himself. He would raise the fowl  
himself. But when that musical meal appeared before you  
none of the drudgery showed.

6. The author most likely refers to the “flea” in line 4 in order to
- (A) highlight Ellington’s prodigious memory
  - (B) emphasize the quality of Ellington’s listening skills
  - (C) indicate Ellington’s interest in different animal sounds
  - (D) suggest that Ellington’s compositions were marked by rhythmic similarities
  - (E) imply that Ellington could be overly concerned about minutia
7. In lines 5-11 (“For him . . . drudgery showed”), the author’s point is primarily developed through the use of
- (A) comparison and contrast
  - (B) appeal to emotion
  - (C) exaggeration
  - (D) metaphor
  - (E) humor

**Questions 8-9 are based on the following passage.**

Line In the summer of 1911, the explorer Hiram Bingham III  
5 bushwhacked his way to a high ridge in the Andes of Peru  
and beheld a dreamscape out of the past. There, set against  
looming peaks cloaked in snow and wreathed in clouds,  
was Machu Picchu, the famous “lost city” of the Incas.  
This expression, popularized by Bingham, served as  
a magical elixir for rundown imaginations. The words  
evoked the romanticism of exploration and archaeology  
at the time. But finding Machu Picchu was easier than  
10 solving the mystery of its place in the rich and powerful  
Inca empire. The imposing architecture attested to the skill  
and audacity of the Incas. But who had lived at this isolated  
site and for what purpose?

8. The words “magical elixir” (line 7) primarily emphasize the
- (A) motivation for an expedition
  - (B) captivating power of a phrase
  - (C) inspiration behind a discovery
  - (D) creative dimension of archaeology
  - (E) complexity of an expression
9. The “mystery” discussed in lines 10-13 is most analogous to that encountered in which of the following situations?
- (A) Being unable to locate the source of materials used to construct an ancient palace
  - (B) Being unable to reconcile archaeological evidence with mythical descriptions of an ancient city
  - (C) Being unable to explain how ancient peoples constructed imposing monuments using only primitive technology
  - (D) Being unable to understand the religious function of a chamber found inside an ancient temple
  - (E) Being unable to discover any trace of a civilization repeatedly mentioned by ancient authors

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Questions 10-14 are based on the following passage.

*This passage is from the preface to a 1997 book by a United States journalist detailing a disagreement between doctors and family members about a child's medical treatment at a hospital in California.*

Under my desk I keep a large carton of cassette tapes. Though they have all been transcribed, I still like to listen to them from time to time.

Line Some are quiet and easily understood. They are filled  
5 with the voices of American doctors, interrupted occasionally by the clink of a coffee cup or beep of a pager. The rest—more than half of them—are very noisy. They are filled with the voices of the Lees family, Hmong refugees from Laos who came to the United States in 1980. Against  
10 a background of babies crying, children playing, doors slamming, dishes clattering, a television yammering, and an air conditioner wheezing, I can hear the mother's voice, by turns breathy, nasal, gargly, or humlike as it slides up and down the Hmong language's eight tones; the father's voice,  
15 louder, slower, more vehement; and my interpreter's voice, mediating in Hmong and English, low and deferential in each. The hubbub summons sense-memories: the coolness of the red metal folding chair, reserved for guests, that was always set up when I arrived in the apartment; the shadows  
20 cast by the amulet that hung from the ceiling and swung in the breeze on its length of grocer's twine; the tastes of Hmong food.

I sat on the Lees' red chair for the first time on May 19, 1988. Earlier that spring I had come to Merced,  
25 California, because I had heard that there were some misunderstandings at the county hospital between its Hmong patients and medical staff. One doctor called them "collisions," which made it sound as if two different kinds of people had rammed into each other, head on, to the  
30 accompaniment of squealing brakes and breaking glass. As it turned out, the encounters were messy but rarely frontal. Both sides were wounded, but neither side seemed to know what had hit it or how to avoid another crash.

I have always felt that the action most worth watching  
35 occurs not at the center of things but where edges meet. I like shorelines, weather fronts, international borders. These places have interesting frictions and incongruities, and often, if you stand at the point of tangency, you can see both sides better than if you were in the middle of either  
40 one. This is especially true when the apposition is cultural. When I first came to Merced, I hoped that the culture of American medicine, about which I knew a little, and the culture of the Hmong, about which I knew nothing, would somehow illuminate each other if I could position myself  
45 between the two and manage not to get caught in the cross-fire. But after getting to know the Lees family and their

daughter's doctors and realizing how hard it was to blame anyone, I stopped analyzing the situation in such linear terms. Now, when I play the tapes late at night, I imagine  
50 what they would sound like if I could splice them together, so the voices of the Hmong and those of the American doctors could be heard on a single tape, speaking a common language.

10. In line 17, "summons" most nearly means

- (A) sends for
- (B) calls forth
- (C) requests
- (D) orders
- (E) convenes

11. It can be inferred from lines 27-33 that "collisions" was NOT an apt description because the

- (A) clash between Hmong patients and medical staff was indirect and baffling
- (B) Hmong patients and the medical staff were not significantly affected by the encounters
- (C) medical staff was not responsible for the dissatisfaction of the Hmong patients
- (D) misunderstandings between the Hmong patients and the medical staff were easy to resolve
- (E) disagreement reached beyond particular individuals to the community at large

12. Which of the following views of conflict is best supported by lines 37-40 ("These . . . one") ?

- (A) Efforts to prevent conflicts are not always successful.
- (B) Conflict can occur in many different guises.
- (C) In most conflicts, both parties are to blame.
- (D) You can understand two parties that have resolved their conflicts better than two parties that are currently in conflict.
- (E) You can learn more about two parties in conflict as an observer than as an involved participant.

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13. According to lines 41-46 (“When I . . . crossfire”), the author’s initial goal was to

- (A) consider the perspectives of both the American doctors and the Lees family to see what insights might develop
- (B) serve as a counselor to the county hospital’s Hmong patients in order to ease their anxieties
- (C) work out a compromise between the American doctors and the Lees family
- (D) acquire a greater knowledge of how the American medical culture serves patients
- (E) try to reduce the misunderstandings between the American doctors and the Lees family and promote good will

14. At the end of the passage, the author suggests that it would be ideal if the

- (A) differences between the Lees family and the American doctors could be resolved quickly
- (B) concerns and opinions of the Lees family and the American doctors could be merged
- (C) American doctors could take the time to learn more about their Hmong patients
- (D) Hmong patients could become more vocal in defense of their rights
- (E) Hmong patients could get medical treatment consistent with their cultural beliefs

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Questions 15-23 are based on the following passages.

*“Cloning” is the creation of a new individual from the unique DNA (or genetic information) of another. The successful cloning of a sheep named Dolly in 1997 sparked a debate over the implications of cloning humans. Each of the passages below was written in 1997.*

### Passage 1

Cloning creates serious issues of identity and individuality. The cloned person may experience concerns about his or her distinctive identity, not only because the person will be in genotype (genetic makeup) and appearance identical to another human being, but, in this case, because he or she may also be twin to the person who is the “father” or “mother”—if one can still call them that. What would be the psychic burdens of being the “child” or “parent” of your twin? The cloned individual, moreover, will be saddled with a genotype that has already lived. He or she will not be fully a surprise to the world.

People will likely always compare a clone’s performance in life with that of the original. True, a cloned person’s nurture and circumstances in life will be different; genotype is not exactly destiny. Still, one must also expect parental and other efforts to shape this new life after the original—or at least to view the child with the original vision always firmly in mind. Why else then would they clone from the star basketball player, mathematician, and beauty queen—or even dear old dad—in the first place?

Since the birth of Dolly, there has been a fair amount of doublespeak on this matter of genetic identity. Experts have rushed in to reassure the public that the clone would in no way be the same person, or have any confusions about his or her identity; they are pleased to point out that the clone of film star Julia Roberts would not be Julia Roberts. Fair enough. But one is shortchanging the truth by emphasizing the additional importance of the environment, rearing, and social setting: genotype obviously matters plenty. That, after all, is the only reason to clone, whether human beings or sheep. The odds that clones of basketball star Larry Bird will play basketball are, I submit, infinitely greater than they are for clones of jockey Willie Shoemaker.

### Passage 2

Given all the brouhaha, you’d think it was crystal clear why cloning human beings is unethical. But what exactly is wrong with it? What would a clone be? Well, he or she would be a complete human being who happens to share the same genes with another person. Today, we call such people identical twins. To my knowledge no one has argued that twins are immoral. “You should treat all clones like you would treat all monozygous [identical] twins or triplets,” concludes Dr. H. Tristram Engelhardt, a professor

of medicine at Baylor and a philosopher at Rice University. “That’s it.” It would be unethical to treat a human clone as anything other than a human being.

Some argue that the existence of clones would undermine the uniqueness of each human being. “Can individuality, identity, and dignity be severed from genetic distinctiveness, and from belief in a person’s open future?” asks political thinker George Will. Will and others have fallen under the sway of what one might call “genetic essentialism,” the belief that genes almost completely determine who a person is. But a person who is a clone would live in a very different world from that of his or her genetic predecessor. With greatly divergent experiences, their brains would be wired differently. After all, even twins who grow up together are separate people—distinct individuals with different personalities and certainly no lack of Will’s “individuality, identity, and dignity.”

But what about cloning exceptional human beings? George Will put it this way: “Suppose a clone of basketball star Michael Jordan, age 8, preferred violin to basketball? Is it imaginable? If so, would it be tolerable to the cloner?” Yes, it is imaginable, and the cloner would just have to put up with violin recitals. Kids are not commercial property. Overzealous parents regularly push their children into sports, music, and dance lessons, but given the stubborn nature of individuals, those parents rarely manage to make kids stick forever to something they hate. A ban on cloning wouldn’t abolish pushy parents.

15. The authors of both passages agree that

- (A) genetic characteristics alone cannot determine a person’s behavior
- (B) a formal code of ethical rules will be needed once human beings can be cloned
- (C) people who are cloned from others may have greater professional opportunities
- (D) identical twins and triplets could provide useful advice to people related through cloning
- (E) cloning human beings is a greater technological challenge than cloning sheep

16. In line 13, the author of Passage 1 uses the word “True” to indicate

- (A) acknowledgement that the passage’s opening arguments are tenuous
- (B) recognition of a potential counterargument
- (C) conviction about the accuracy of the facts presented
- (D) distrust of those who insist on pursuing cloning research
- (E) certainty that cloning will one day become commonplace

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17. The question in lines 18-20 (“Why else . . . first place”) chiefly serves to
- (A) suggest that some issues are not easily resolved
  - (B) argue for the importance of parents in the lives of children
  - (C) offer an anecdote revealing the flaw in a popular misconception
  - (D) imply that cloning might displace more familiar means of reproduction
  - (E) suggest the value perceived in a person who might be selected for cloning
18. In line 21, “fair” most nearly means
- (A) considerable
  - (B) pleasing
  - (C) ethical
  - (D) just
  - (E) promising
19. The author of Passage 1 mentions two sports stars (lines 31-33) in order to
- (A) argue against genetic analysis of any sports star’s physical abilities
  - (B) distinguish between lasting fame and mere celebrity
  - (C) clarify the crucial role of rigorous, sustained training
  - (D) highlight the need for greater understanding of the athletes’ genetic data
  - (E) suggest that athletes’ special skills have a genetic component
20. In line 49, “open” most nearly means
- (A) overt
  - (B) frank
  - (C) unrestricted
  - (D) unprotected
  - (E) public
21. In line 55, “divergent experiences” emphasizes that which of the following is particularly important for a developing child?
- (A) Character
  - (B) Heritage
  - (C) Intelligence
  - (D) Environment
  - (E) Personality
22. In the quotation in lines 61-64, George Will primarily draws attention to
- (A) a weakness inherent in cloning theory
  - (B) a goal that some advocates of cloning might share
  - (C) the limitations of human individuality
  - (D) the likelihood that children will rebel against their parents
  - (E) the extent to which a cloned person might differ from the original person
23. Both passages base their arguments on the unstated assumption that
- (A) genetic distinctiveness is crucial to human survival as a species
  - (B) public concern about human cloning will eventually diminish
  - (C) human cloning is a genuine possibility in the future
  - (D) individualism is less prized today than it has been in the past
  - (E) technological advances have had a mostly positive impact on society

**STOP**

If you finish before time is called, you may check your work on this section only.  
Do not turn to any other section in the test.



**SECTION 5**

Time — 25 minutes

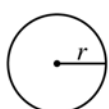
20 Questions

**Turn to Section 5 (page 5) of your answer sheet to answer the questions in this section.**
**Directions:** For this section, solve each problem and decide which is the best of the choices given. Fill in the corresponding circle on the answer sheet. You may use any available space for scratchwork.

Notes

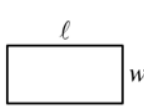
1. The use of a calculator is permitted.
2. All numbers used are real numbers.
3. Figures that accompany problems in this test are intended to provide information useful in solving the problems. They are drawn as accurately as possible EXCEPT when it is stated in a specific problem that the figure is not drawn to scale. All figures lie in a plane unless otherwise indicated.
4. Unless otherwise specified, the domain of any function  $f$  is assumed to be the set of all real numbers  $x$  for which  $f(x)$  is a real number.

Reference Information

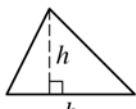


$$A = \pi r^2$$

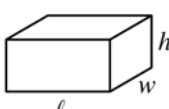
$$C = 2\pi r$$



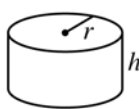
$$A = \ell w$$



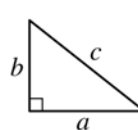
$$A = \frac{1}{2}bh$$



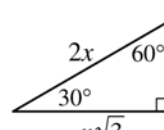
$$V = \ell wh$$



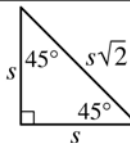
$$V = \pi r^2 h$$



$$c^2 = a^2 + b^2$$



Special Right Triangles



The number of degrees of arc in a circle is 360.

The sum of the measures in degrees of the angles of a triangle is 180.

1. Each of the following is a factor of 80 EXCEPT

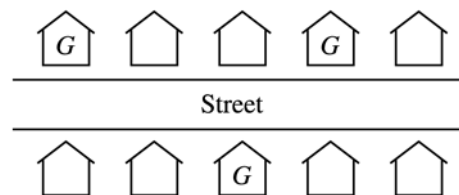
- (A) 5  
(B) 8  
(C) 12  
(D) 16  
(E) 40

$$k = 3wx$$

$$m = (w - 1)k$$

2. If  $k$  and  $m$  are defined by the equations above, what is the value of  $m$  when  $w = 4$  and  $x = 1$ ?

- (A) 0  
(B) 3  
(C) 12  
(D) 24  
(E) 36



3. There are five houses on each side of a street, as shown in the figure above. No two houses next to each other on the same side of the street and no two houses directly across from each other on opposite sides of the street can be painted the same color. If the houses labeled  $G$  are painted gray, how many of the seven remaining houses cannot be painted gray?

- (A) Two  
(B) Three  
(C) Four  
(D) Five  
(E) Six

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4. If  $7^n \times 7^3 = 7^{12}$ , what is the value of  $n$ ?

- (A) 2  
(B) 4  
(C) 9  
(D) 15  
(E) 36

PRICES

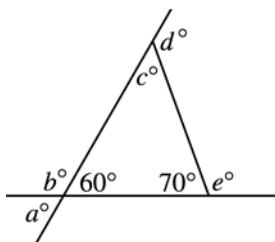
	Table	Chair
1990	\$240	\$25
1995	\$265	\$30
2000	\$280	\$36

INVENTORY  
CAPACITY

	Warehouse		
	X	Y	Z
Tables	30	80	30
Chairs	125	200	140

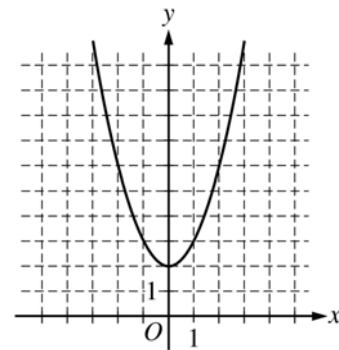
5. A furniture company makes one style of tables and chairs. The chart on the left above gives the prices of these tables and chairs in three different years. The chart on the right gives the maximum number of tables and chairs that can be stocked in each of three warehouses, X, Y, and Z. Based on the prices shown, what was the maximum possible value of the table and chair inventory in warehouse Y in 1995?

- (A) \$23,950  
(B) \$26,500  
(C) \$27,200  
(D) \$28,400  
(E) \$29,500



6. In the figure above, which of the following is greatest?

- (A)  $a$   
(B)  $b$   
(C)  $c$   
(D)  $d$   
(E)  $e$



7. Which of the following could be the equation of the graph above?

- (A)  $y = x^2 + 2$   
(B)  $y = (x + 2)^2$   
(C)  $y = x^2 - 2$   
(D)  $y = (x - 2)^2$   
(E)  $y = 2x^2$

8. What is the total number of right angles formed by the edges of a cube?

- (A) 36  
(B) 24  
(C) 20  
(D) 16  
(E) 12

9. If  $(p + 1)(t - 3) = 0$  and  $p$  is positive, what is the value of  $t$ ?

- (A)  $-3$   
(B)  $-1$   
(C)  $0$   
(D)  $1$   
(E)  $3$

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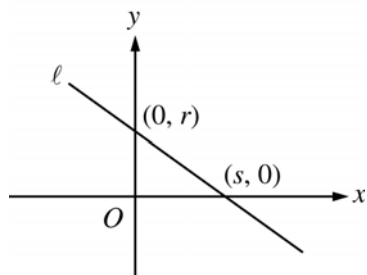
$(x, y)$
$(0, 100)$
$(1, 99)$
$(2, 96)$

10. Which of the following equations describes  $y$  in terms of  $x$  for all ordered pairs in the table above?

- (A)  $y = 100 - x^2$   
 (B)  $y = 100 - x$   
 (C)  $y = 100 - 2x$   
 (D)  $y = 100 - 4x$   
 (E)  $y = 100 - 100x$

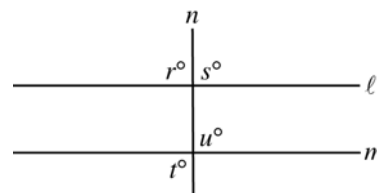
11. A stamp collecting club calculated that the average (arithmetic mean) number of stamps in its members' 10 collections was 88. However, it was discovered that 2 numbers in the calculations were entered incorrectly. The number 55 was entered as 75 and the number 78 as 88. What is the correct average number of stamps in the 10 collections?

- (A) 91  
 (B) 89  
 (C) 87  
 (D) 86  
 (E) 85



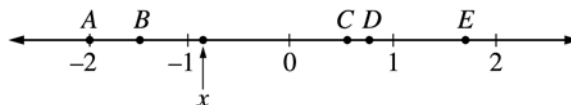
12. In the figure above, what is the slope of line  $\ell$ ?

- (A)  $-\frac{r}{s}$   
 (B)  $\frac{r}{s}$   
 (C)  $-\frac{s}{r}$   
 (D)  $\frac{s}{r}$   
 (E)  $-\frac{1}{rs}$



13. In the figure above, if  $\ell \parallel m$  and  $r = 91$ , then  $t + u =$

- (A) 178  
 (B) 179  
 (C) 180  
 (D) 181  
 (E) 182



14. If  $x$  is the coordinate of the indicated point on the number line above, which of the lettered points has coordinate  $-2x$ ?

- (A) A  
 (B) B  
 (C) C  
 (D) D  
 (E) E

15. Points  $X$  and  $Y$  are two different points on a circle. Point  $M$  is located so that line segment  $\overline{XM}$  and line segment  $\overline{YM}$  have equal length. Which of the following could be true?

- I.  $M$  is the center of the circle.  
 II.  $M$  is on arc  $\widehat{XY}$ .  
 III.  $M$  is outside of the circle.

- (A) I only  
 (B) II only  
 (C) I and II only  
 (D) II and III only  
 (E) I, II, and III

5

□

5

□

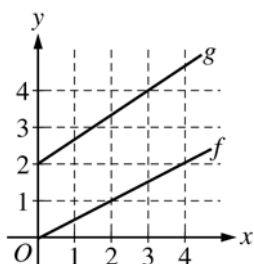
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□

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□

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16. The graphs of the functions  $f$  and  $g$  are lines, as shown above. What is the value of  $f(3) + g(3)$ ?

(A) 1.5  
(B) 2  
(C) 3  
(D) 4  
(E) 5.5

17. If  $A$  is the set of prime numbers and  $B$  is the set of two-digit positive integers whose units digit is 5, how many numbers are common to both sets?

(A) None  
(B) One  
(C) Two  
(D) Five  
(E) Nine

18. If 75 percent of  $m$  is equal to  $k$  percent of 25, where  $k > 0$ , what is the value of  $\frac{m}{k}$ ?

(A)  $\frac{3}{16}$   
(B)  $\frac{1}{3}$   
(C)  $\frac{3}{4}$   
(D) 3  
(E)  $\frac{16}{3}$

19.  $R$  is the midpoint of line segment  $\overline{PT}$ , and  $Q$  is the midpoint of line segment  $\overline{PR}$ . If  $S$  is a point between  $R$  and  $T$  such that the length of segment  $\overline{QS}$  is 10 and the length of segment  $\overline{PS}$  is 19, what is the length of segment  $\overline{ST}$ ?

(A) 13  
(B) 14  
(C) 15  
(D) 16  
(E) 17

20. A telephone company charges  $x$  cents for the first minute of a call and charges for any additional time at the rate of  $y$  cents per minute. If a certain call costs \$5.55 and lasts more than 1 minute, which of the following expressions represents the length of that call, in minutes?

(A)  $\frac{555 - x}{y}$   
(B)  $\frac{555 + x - y}{y}$   
(C)  $\frac{555 - x + y}{y}$   
(D)  $\frac{555 - x - y}{y}$   
(E)  $\frac{555}{x + y}$

# STOP

If you finish before time is called, you may check your work on this section only.  
Do not turn to any other section in the test.

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6

**SECTION 6****Time — 25 minutes****25 Questions****Turn to Section 6 (page 6) of your answer sheet to answer the questions in this section.****Directions:** For each question in this section, select the best answer from among the choices given and fill in the corresponding circle on the answer sheet.

Each sentence below has one or two blanks, each blank indicating that something has been omitted. Beneath the sentence are five words or sets of words labeled A through E. Choose the word or set of words that, when inserted in the sentence, best fits the meaning of the sentence as a whole.

**Example:**

Hoping to ----- the dispute, negotiators proposed a compromise that they felt would be ----- to both labor and management.

- (A) enforce . . useful  
(B) end . . divisive  
(C) overcome . . unattractive  
(D) extend . . satisfactory  
(E) resolve . . acceptable

(A) (B) (C) (D) ●

- Common garlic has ----- properties; during the First World War British medics saved thousands of lives by wrapping wounds with garlic-soaked bandages.  
(A) curative (B) flavoring (C) inferior  
(D) questionable (E) infamous
- In her poems, Alice Walker retrieves and ----- parts of Black culture that some have been all too quick to ----- the past as fossilized artifacts.  
(A) revitalizes . . consign to  
(B) conjoins . . exclude from  
(C) realigns . . salvage from  
(D) diffuses . . defer to  
(E) refracts . . impose on
- The modest acceptance speech of the Academy Award-winning actress revealed a ----- that contrasted with her uninhibited screen performances.  
(A) theatricality (B) sullenness  
(C) flamboyance (D) reserve  
(E) nonchalance
- Because howler monkeys rarely come out of the trees in their arboreal habitat, the continued well-being of the rain forest is ----- to their survival.  
(A) inadequate (B) tangential  
(C) indispensable (D) baneful  
(E) expeditious
- Doug was both ----- and -----: he possessed penetrating acuity and discernment and was also extremely humble.  
(A) diligent . . supercilious  
(B) perspicacious . . unpretentious  
(C) obtuse . . penitent  
(D) sagacious . . imposing  
(E) apologetic . . unassuming
- The *Mona Lisa*, shipped in a private cabin and received by important dignitaries, was treated more like ----- than a painting upon its arrival in the United States.  
(A) a perfectionist (B) a maverick (C) a potentate  
(D) an ascetic (E) an interloper
- Despite its patent -----, this belief has become so ----- that no amount of rational argument will suffice to eradicate it.  
(A) validity . . inconsequential  
(B) implausibility . . entrenched  
(C) credibility . . prevalent  
(D) absurdity . . outmoded  
(E) novelty . . infrequent
- The charlatan's seemingly frank and open demeanor was actually a ----- means of enlisting his patient's confidence.  
(A) disingenuous (B) debilitating  
(C) diminutive (D) cathartic  
(E) prosaic

**GO ON TO THE NEXT PAGE** 

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The passages below are followed by questions based on their content; questions following a pair of related passages may also be based on the relationship between the paired passages. Answer the questions on the basis of what is stated or implied in the passages and in any introductory material that may be provided.

Questions 9-13 are based on the following passages.

### Passage 1

Line It is striking how our culture has wholeheartedly  
5 adopted the recycling ethic. Most parents have probably  
received humbling lectures from their children after tossing  
a glass jar or newspaper in the trash can. But the popularity  
of recycling is even more surprising considering the inconveniences associated with it. Who hasn't experienced the  
annoyance of trying to satisfy complicated rules about what  
can and cannot be recycled? Glass jars—but not their tops?  
10 Plastics number 1 and 2—but not number 3? Still there is  
no sign that the public is becoming impatient, so convinced  
are people of the virtues of recycling.

### Passage 2

Mandatory recycling programs aren't good for posterity.  
They offer mainly short-term benefits to a few groups—  
like politicians and waste-handling corporations—while  
15 diverting money from genuine social and environmental  
problems. Recycling programs actually consume resources.  
They require extra administrators and a continual public  
relations campaign explaining what to do with dozens of  
different products—recycle milk jugs but not milk cartons,  
20 index cards but not construction paper. Collecting a ton of  
recyclable items is three times more expensive than collect-  
ing a ton of garbage because crews pick up less material  
at each stop. Recycling may be the most wasteful activity  
in the modern United States: a waste of time and money,  
25 a waste of human and natural resources.

9. Which statement best characterizes the relationship between Passage 1 and Passage 2?

- (A) Passage 1 presents ethical objections to an action that Passage 2 also censures.
- (B) Passage 1 mocks a group of people that Passage 2 praises.
- (C) Passage 1 describes a cultural phenomenon that Passage 2 criticizes.
- (D) Passage 1 discusses the historical foundations of recycling, whereas Passage 2 considers the future of recycling.
- (E) Passage 1 describes people's fascination with recycling, whereas Passage 2 explains the process of sorting recyclables.

10. Unlike Passage 1, Passage 2 focuses primarily on recycling's

- (A) philosophical foundations
- (B) economic impact
- (C) popular appeal
- (D) moral implications
- (E) environmental benefits

11. The author of Passage 2 would most likely characterize the "people" mentioned in line 11 as

- (A) emotional
- (B) indecisive
- (C) unmotivated
- (D) undemanding
- (E) uninformed

12. The authors of both passages would most likely agree that recycling rules are

- (A) convoluted
- (B) commendable
- (C) unethical
- (D) antiquated
- (E) unenforceable

13. Compared to the tone of Passage 2, the tone of Passage 1 is more

- (A) pessimistic
- (B) arrogant
- (C) critical
- (D) scholarly
- (E) tempered

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**Questions 14-25 are based on the following passage.**

*This passage is taken from a novel set in early twentieth-century England. Mrs. Deverell is the widow of a shopkeeper who lived and worked in Volunteer Street; their daughter Angel has become a best-selling novelist. Here, Mrs. Deverell finds herself in a new home that she and Angel share in the prosperous village of Alderhurst.*

“I never thought I would live in such a beautiful place,” Mrs. Deverell told Angel when they first moved in. But nowadays she often suffered from the lowering pain of believing herself happy when she was not. “Who could be miserable in such a place?” she asked. Yet, on misty October evenings or on Sundays, when the church bells began, sensations she had never known before came over her.

She sometimes felt better when she went back to see her friends on Volunteer Street; but it was a long way to go. Angel discouraged the visits, and her friends seemed to have changed. Either they put out their best china and thought twice before they said anything, or they were defiantly informal—“You’ll have to take us as you find us”—and would persist in making remarks like “Pardon the apron, but there’s no servants here to polish the grate.” In each case, they were watching her for signs of grandeur or condescension. She fell into little traps they laid and then they were able to report to the neighbors. “It hasn’t taken *her* long to start putting on airs.” She had to be especially careful to recognize everyone she met, and walked up the street with an expression of anxiety which was misinterpreted as disdain.

The name “Deverell Family Grocer” stayed for a long time over the shop, and she was pleased that it should, although Angel frowned with annoyance when she heard of it. Then one day the faded name was scraped and burnt away, and on her next visit to Volunteer Street, she saw that “Cabbage’s Stores” was painted there instead. She felt an unaccountable panic and dismay at the sight of this and at the strange idea of other people and furniture in those familiar rooms. “Very nice folk,” she was told. “She’s so friendly. Always the same. And such lovely kiddies.” Mrs. Deverell felt slighted and wounded; going home she was so preoccupied that she passed the wife of the landlord of The Volunteer without seeing her. “I wouldn’t expect Alderhurst people to speak to a barkeep’s wife,” the woman told everyone in the saloon bar. “Even though it was our Gran who laid her husband out when he died.” All of their kindnesses were remembered and brooded over; any past kindness Mrs. Deverell had done—and they were many—only served to underline the change which had come over her.

At a time of her life when she needed the security of familiar things, these were put beyond her reach. It seemed to her that she had wasted her years acquiring skills which in the end were to be of no use to her: her weather-eye for

a good drying day; her careful ear for judging the gentle singing sound of meat roasting in the oven; her touch for the freshness of meat; and how, by smelling a cake, she could tell if it were baked. These arts, which had taken so long to perfect, fell now into disuse. She would never again, she grieved, gather up a great fragrant line of washing in her arms to carry indoors. One day when they had first come to the new house, she had passed through the courtyard where sheets were hanging out: she had taken them in her hands and, finding them just at the right stage of drying, had begun to unpeg them. They were looped all about her shoulders when Angel caught her. “Please leave work to the people who should do it,” she had said. “You will only give offense.” She tried hard not to give offense; but it was difficult. The smell of ironing being done or the sound of eggs being whisked set up a restlessness which she could scarcely control.

The relationship of mother and daughter seemed to have been reversed, and Angel, now in her early twenties, was the authoritative one; since girlhood she had been taking on one responsibility after another, until she had left her mother with nothing to perplex her but how to while away the hours when the servants were busy and her daughter was at work. Fretfully, she would wander around the house, bored, but afraid to interrupt; she was like an intimidated child.

14. Which interpretation of Mrs. Deverell’s statement in line 1 (“I never . . . place”) is most fully supported by the rest of the passage?
- (A) It reveals an unsatisfied longing for beauty and comfort.
  - (B) It suggests that Mrs. Deverell is unprepared for her new life.
  - (C) It illustrates Mrs. Deverell’s desire to impress her old friends.
  - (D) It hints at Mrs. Deverell’s increasing discomfort with her daughter’s career.
  - (E) It indicates Mrs. Deverell’s inability to be happy in an environment.
15. The “sensations” (line 7) might best be described as feelings of
- (A) anger and bitterness
  - (B) reverence and gratitude
  - (C) dejection and isolation
  - (D) nostalgia and serenity
  - (E) empathy and concern

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16. The primary purpose of the second paragraph (lines 9-23) is to show Mrs. Deverell's
  - (A) surprise that her friends have not forgotten her
  - (B) nostalgia for her old neighborhood
  - (C) feelings of superiority toward her friends
  - (D) embarrassment about her former neighborhood
  - (E) changing relationship with her friends
17. The author most likely quotes Mrs. Deverell's friends in lines 14-16 in order to
  - (A) voice a concern
  - (B) dismiss a belief
  - (C) illustrate an attitude
  - (D) cite an authority
  - (E) mock an undertaking
18. The speaker of the sentence quoted in lines 15-16 ("Pardon . . . grate") most likely intends to
  - (A) account for a peculiar style of dress
  - (B) bemoan the lack of adequate help around the house
  - (C) frankly apologize for the messiness of the family's home
  - (D) indirectly express resentment about a difference in social status
  - (E) overtly call attention to Mrs. Deverell's arrogant behavior
19. Mrs. Deverell's reaction to the remarks quoted in lines 32-33 suggests that she thinks that these remarks
  - (A) contain an implicit criticism
  - (B) mischaracterize the new family
  - (C) are a poor attempt at humor
  - (D) stem from an old grudge
  - (E) insult the memory of her husband
20. Lines 40-43 ("All of . . . her") suggest which of the following about the customers in the saloon bar?
  - (A) They do not recall those occasions when Mrs. Deverell was kind to them.
  - (B) They feel that Mrs. Deverell is still essentially the same person that she has always been.
  - (C) They are not especially well acquainted with Mrs. Deverell.
  - (D) They are more generous toward themselves than they are toward Mrs. Deverell.
  - (E) They do not generally share the opinions of the barkeeper's wife.
21. Lines 45-52 ("It . . . disuse") suggest which of the following about the way that Mrs. Deverell had viewed the task of running a household?
  - (A) She had believed some elements of it were beneath her.
  - (B) She had understood the importance of its sensory aspects.
  - (C) She had developed a regimented system.
  - (D) She had been afraid to ask Angel for her help.
  - (E) She had relied on household help to perform certain chores.
22. The use of "arts" in line 51 most directly emphasizes the
  - (A) pride Mrs. Deverell's family took in her housekeeping skills
  - (B) expertise Mrs. Deverell brought to her household tasks
  - (C) importance of maintaining an orderly home
  - (D) rewards of preparing elaborate meals
  - (E) pleasure Mrs. Deverell found in teaching young servants

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23. Angel's comments in lines 60-61 ("Please . . . offense'") imply that
- (A) Mrs. Deverell has inadequate housekeeping experience
  - (B) many people enjoy the opportunity to perform household tasks
  - (C) Mrs. Deverell often hurts the feelings of others
  - (D) domestic tasks are unsuitable for Mrs. Deverell's new social status
  - (E) Mrs. Deverell is not a particularly efficient worker

24. In line 69, "perplex" most nearly means

- (A) trouble
- (B) bewilder
- (C) astonish
- (D) entangle
- (E) embarrass

25. In line 73, the author compares Mrs. Deverell to an "intimidated child" primarily in order to

- (A) criticize Mrs. Deverell for her naive view of the world
- (B) show that Mrs. Deverell continues to be diminished in her new home
- (C) imply that Mrs. Deverell cannot live up to her responsibilities
- (D) indicate the simplicity of Mrs. Deverell's new life
- (E) justify Angel's dismissal of her mother's feelings

**STOP**

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## SECTION 8

Time — 20 minutes

16 Questions

Turn to Section 8 (page 7) of your answer sheet to answer the questions in this section.

**Directions:** For this section, solve each problem and decide which is the best of the choices given. Fill in the corresponding circle on the answer sheet. You may use any available space for scratchwork.

Notes

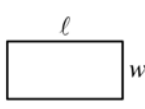
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Reference Information

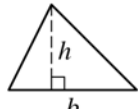


$$A = \pi r^2$$

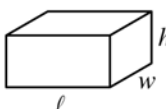
$$C = 2\pi r$$



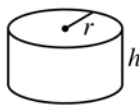
$$A = \ell w$$



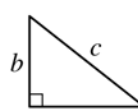
$$A = \frac{1}{2}bh$$



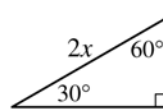
$$V = \ell wh$$



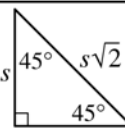
$$V = \pi r^2 h$$



$$c^2 = a^2 + b^2$$



Special Right Triangles

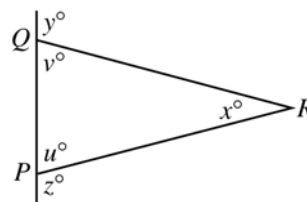


The number of degrees of arc in a circle is 360.

The sum of the measures in degrees of the angles of a triangle is 180.

1. Conall had a box of 36 candy bars to sell for a class fundraiser. He sold 10 of the bars on his own, and his mother sold half of the remaining bars to her coworkers. If no other bars were sold, what fraction of Conall's original 36 bars remained unsold?

- (A)  $\frac{5}{8}$   
 (B)  $\frac{11}{36}$   
 (C)  $\frac{1}{3}$   
 (D)  $\frac{13}{36}$   
 (E)  $\frac{7}{18}$



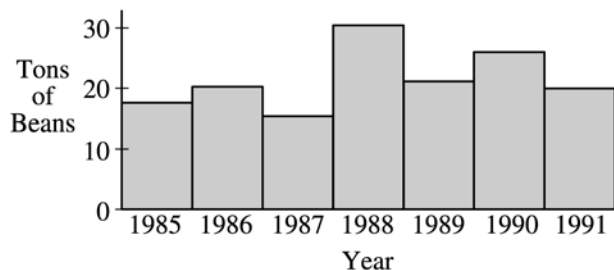
2. In  $\triangle PQR$  above,  $PR = QR$ . Which of the following must be true?

- (A)  $u = x$   
 (B)  $x = v$   
 (C)  $x = z$   
 (D)  $y = x$   
 (E)  $y = z$

GO ON TO THE NEXT PAGE



BEAN PRODUCTION



3. The bar graph above shows the number of tons of beans produced on a large farm for the years 1985 through 1991. For which of the following two-year periods was the average (arithmetic mean) bean production closest to the bean production in 1985 ?

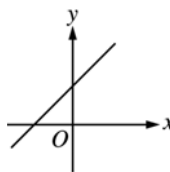
(A) 1986-1987  
 (B) 1987-1988  
 (C) 1988-1989  
 (D) 1989-1990  
 (E) 1990-1991

4. Marcus can spend no more than \$120 on jeans and shirts for school. He buys 3 pairs of jeans at \$32 each. If  $x$  represents the dollar amount he can spend on shirts, which of the following inequalities could be used to determine the possible values for  $x$  ?

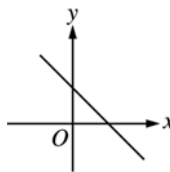
(A)  $(3) \cdot 32 - x \leq 120$   
 (B)  $(3) \cdot 32 - x \geq 120$   
 (C)  $(3) \cdot 32 + x \leq 120$   
 (D)  $(3) \cdot 32 + x \geq 120$   
 (E)  $x \leq (3) \cdot 32$

5. If  $y$  is directly proportional to  $x$ , which of the following could be the graph that shows the relationship between  $y$  and  $x$  ?

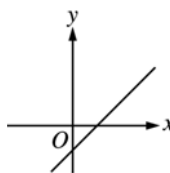
(A)



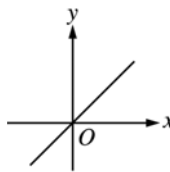
(B)



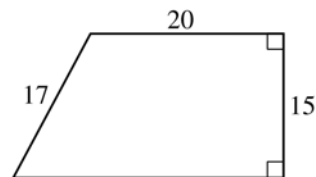
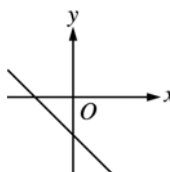
(C)



(D)



(E)



6. What is the perimeter of the trapezoid above?

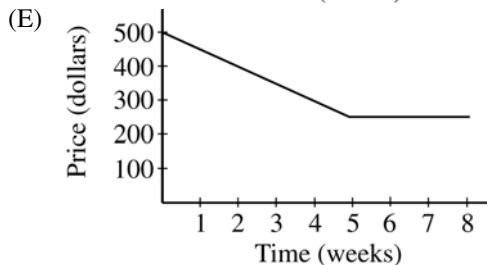
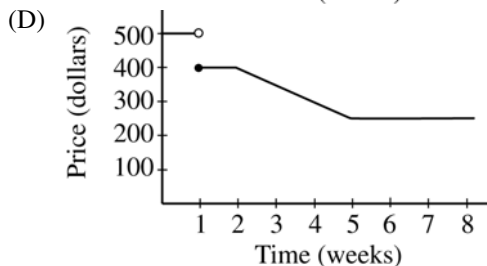
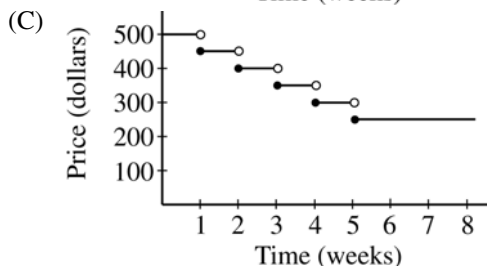
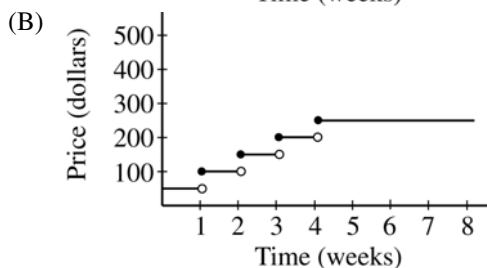
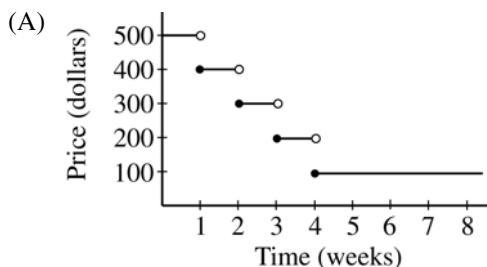
(A) 52  
 (B) 72  
 (C) 75  
 (D) 80  
 (E) 87

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7. A store discounts merchandise by 10 percent of the original price at the end of each week and stops when the merchandise is priced at 50 percent of the original price. Which of the following graphs could correctly represent the price of an article of merchandise over an eight-week period?



8. If  $\frac{x+y}{a-b} = \frac{2}{3}$ , then  $\frac{9x+9y}{10a-10b} =$

(A)  $\frac{9}{10}$

(B)  $\frac{20}{23}$

(C)  $\frac{20}{27}$

(D)  $\frac{2}{3}$

(E)  $\frac{3}{5}$

9. The interior dimensions of a rectangular fish tank are 4 feet long, 3 feet wide, and 2 feet high. The water level in the tank is 1 foot high. All of the water in this tank is poured into an empty second tank. If the interior dimensions of the second tank are 3 feet long, 2 feet wide, and 4 feet high, what is the height of the water in the second tank?

(A) 0.5 ft

(B) 1 ft

(C) 1.5 ft

(D) 2 ft

(E) 4 ft

1, 2, 3

10. If  $m$ ,  $n$ , and  $k$  are to be assigned different values from the list above, how many different values will be possible for the expression  $(m+n)^k$ ?

(A) Three

(B) Four

(C) Five

(D) Eight

(E) Nine

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## NUMBER OF EMPLOYEES AT COMPANY X

	First Shift	Second Shift
Salary over \$30,000	30	10
Salary \$30,000 or less	40	20

11. The table above shows the number of employees at Company X classified according to work shift and salary. If a second-shift employee will be picked at random, what is the probability that the employee's salary is over \$30,000?

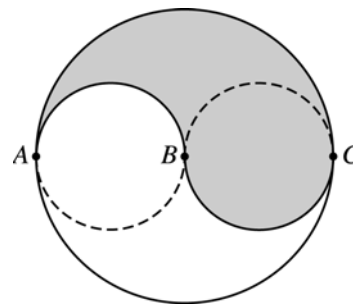
- (A)  $\frac{1}{2}$   
(B)  $\frac{1}{3}$   
(C)  $\frac{1}{10}$   
(D)  $\frac{2}{3}$   
(E)  $\frac{2}{5}$

12. If  $x$  is a positive integer satisfying  $x^7 = k$  and  $x^9 = m$ , which of the following must be equal to  $x^{11}$ ?

- (A)  $\frac{m^2}{k}$   
(B)  $m^2 - k$   
(C)  $m^2 - 7$   
(D)  $2k - \frac{m}{3}$   
(E)  $k + 4$

13. After the first term in a sequence of positive integers, the ratio of each term to the term immediately preceding it is 2 to 1. What is the ratio of the 8th term in this sequence to the 5th term?

- (A) 6 to 1  
(B) 8 to 5  
(C) 8 to 1  
(D) 64 to 1  
(E) 256 to 1

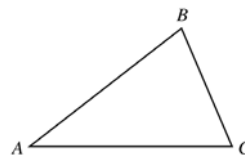


14. In the figure above, the smaller circles each have radius 3. They are tangent to the larger circle at points A and C, and are tangent to each other at point B, which is the center of the larger circle. What is the perimeter of the shaded region?

- (A)  $6\pi$   
(B)  $8\pi$   
(C)  $9\pi$   
(D)  $12\pi$   
(E)  $15\pi$

15. Each of the following inequalities is true for some values of  $x$  EXCEPT

- (A)  $x < x^2 < x^3$   
(B)  $x < x^3 < x^2$   
(C)  $x^2 < x^3 < x$   
(D)  $x^3 < x < x^2$   
(E)  $x^3 < x^2 < x$



Note: Figure not drawn to scale.

16. In the figure above,  $AC = 6$  and  $BC = 3$ . Point  $P$  (not shown) lies on  $\overline{AB}$  between  $A$  and  $B$  such that  $\overline{CP} \perp \overline{AB}$ . Which of the following could be the length of  $\overline{CP}$ ?

- (A) 2  
(B) 4  
(C) 5  
(D) 7  
(E) 8

**STOP**

If you finish before time is called, you may check your work on this section only.  
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**SECTION 9****Time — 20 minutes****19 Questions****Turn to Section 9 (page 7) of your answer sheet to answer the questions in this section.****Directions:** For each question in this section, select the best answer from among the choices given and fill in the corresponding circle on the answer sheet.

Each sentence below has one or two blanks, each blank indicating that something has been omitted. Beneath the sentence are five words or sets of words labeled A through E. Choose the word or set of words that, when inserted in the sentence, best fits the meaning of the sentence as a whole.

**Example:**

Hoping to ----- the dispute, negotiators proposed a compromise that they felt would be ----- to both labor and management.

- (A) enforce . . useful  
(B) end . . divisive  
(C) overcome . . unattractive  
(D) extend . . satisfactory  
(E) resolve . . acceptable

(A) (B) (C) (D) ●

1. Unable to discover how the fire started, the inspectors filed a tentative report stating that the cause was -----.  
(A) noteworthy (B) definitive (C) fundamental  
(D) conclusive (E) indeterminate
2. The celebrants at the ----- party for Cinco De Mayo were understandably ----- by the spectacle of the mariachi bands and the colorful piñatas for the children.  
(A) somber . . amused  
(B) lavish . . dazzled  
(C) novel . . jaded  
(D) mundane . . astounded  
(E) joyous . . stymied

3. “Hawaii” refers both to the group of islands known as the Hawaiian islands and to the largest island in that -----.  
(A) flora (B) sierra (C) archipelago  
(D) flotilla (E) savanna
4. Given the exponential growth of scientific knowledge, medicine is far less ----- unsubstantiated fads than it used to be; its record of folly, however, remains an undeniable -----.  
(A) suspicious of . . qualification  
(B) averse to . . encumbrance  
(C) vulnerable to . . embarrassment  
(D) dependent on . . impossibility  
(E) ignorant of . . oversight
5. The aspiring writer, who remained ----- even after being rejected by several major publishers, felt certain of achieving literary -----.  
(A) hopeless . . vindication  
(B) disgruntled . . talent  
(C) optimistic . . abasement  
(D) undaunted . . celebrity  
(E) obsequious . . neglect
6. Fred often used ----- to achieve his professional goals, even though such artful subterfuge alienated his colleagues.  
(A) chicanery (B) diligence (C) bombast  
(D) disputation (E) consensus

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The passage below is followed by questions based on its content. Answer the questions on the basis of what is stated or implied in the passage and in any introductory material that may be provided.

**Questions 7-19 are based on the following passage.**

*In the following passage from a newspaper commentary written in 1968, an architecture critic discusses old theaters and concert halls.*

Line After 50 years of life and 20 years of death, the great  
Adler and Sullivan Auditorium in Chicago is back in  
business again. Orchestra Hall, also in Chicago, was  
5 beautifully spruced up for its sixty-eighth birthday. In  
St. Louis, a 1925 movie palace has been successfully  
transformed into Powell Symphony Hall, complete with  
handsome bar from New York's demolished Metropolitan  
Opera House.

Sentimentalism? Hardly. This is no more than a  
10 practical coming of cultural age, a belated recognition  
that fine old buildings frequently offer the most for the  
money in an assortment of values, including cost, and  
above all, that new cultural centers do not a culture  
make. It indicates the dawning of certain sensibilities,  
15 perspectives, and standards without which arts programs  
are mockeries of everything the arts stand for.

The last decade has seen city after city rush pell-mell  
into the promotion of great gobs of cultural real estate. It  
has seen a few good new theaters and a lot of bad ones,  
20 temples to bourgeois muses with all the panache of sub-  
urban shopping centers. The practice has been to treat the  
arts in chamber-of-commerce, rather than in creative,  
terms. That is just as tragic as it sounds.

The trend toward preservation is significant not only  
25 because it is saving and restoring some superior buildings  
that are testimonials to the creative achievements of other  
times, but also because it is bucking the conventional  
wisdom of the conventional power structure that provides  
the backing for conventional cultural centers to house the  
30 arts.

That wisdom, as it comes true-blue from the hearts and  
minds of real estate dealers and investment bankers, is that  
you don't keep old buildings; they are obsolete. Anything  
new is better than anything old and anything big is better  
35 than anything small, and if a few cultural values are lost  
along the way, it is not too large a price to pay. In addition,  
the new, big buildings must be all in one place so they will  
show. They'll not only serve the arts, they'll improve the  
surrounding property values. Build now, and fill them later.

40 At the same time, tear down the past, rip out cultural  
roots, erase tradition, rub out the architectural evidence that  
the arts flowered earlier in our cities and enriched them and  
that this enrichment *is* culture. Substitute a safe and sanitary  
status symbol for the loss. Put up the shiny mediocrities of  
45 the present and demolish the shabby masterpieces of the

past. That is the ironic other side of the "cultural explosion"  
coin. In drama, and in life, irony and tragedy go hand in  
hand.

Chicago's Auditorium is such a masterpiece. With its  
50 glowing, golden ambiance, its soaring arches and super-  
stage from which whispers can be heard in the far reaches  
of the theater, it became a legend in its own time. One of  
the great nineteenth-century works of Louis Sullivan and  
Dankmar Adler and an anchor point of modern architectural  
55 history, it has been an acknowledged model of acoustical  
and aesthetic excellence. (Interestingly, the Auditorium is  
a hard theater in which to install microphones today, and  
many modern performers, untrained in balance and pro-  
jection and reliant on technical mixing of sound, find it  
60 hard to function in a near-perfect house.)

Until October 1967, the last performance at the Auditor-  
ium was of *Hellzapoppin'* in 1941, and the last use of the  
great stage was for bowling alleys during the Second World  
War. Closed after that, it settled into decay for the next  
65 20 years. Falling plaster filled the hall, and the golden ceil-  
ing was partly ruined by broken roof drains. Last fall the  
Auditorium reopened, not quite in its old glory, but close  
to it. The splendors of the house were traced in the eight-  
candlepower glory of carbon-filament lightbulbs of the  
70 same kind used in 1889 when the theater, and electricity,  
were new. Their gentle brilliance picked out restored archi-  
tectural features in warm gilt and umber.

We have never had greater technical means or expertise  
to make our landmarks bloom. The question is no longer  
75 whether we can bring old theaters back to new brilliance,  
but whether we can fill them when they're done. As with  
the new centers, that will be the acid cultural test.

7. The principal function of the opening paragraph is to

- (A) introduce the concept of conventional arts centers
- (B) illustrate the trend toward revitalization of cultural landmarks
- (C) explore the connection between classical architecture and the arts
- (D) provide an explanation for the theater's resurgent popularity
- (E) contrast the beauty of old theaters with ordinary modern buildings

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8. On the basis of information provided in the rest of the passage, the word “death” (line 1) best conveys
- (A) flagging attendance
  - (B) wartime malaise
  - (C) demolition
  - (D) neglect
  - (E) disrepute
9. The bar mentioned in line 7 had apparently been
- (A) costly but symbolic
  - (B) beautiful but outdated
  - (C) enlarged and elongated
  - (D) treasured and imitated
  - (E) rescued and relocated
10. The question in line 9 is intended to
- (A) expose the folly of the new construction
  - (B) convey the emotional burdens of the past
  - (C) provide a typical explanation for the renovations
  - (D) lament the decline of cultural values
  - (E) address the public’s indifference toward old buildings
11. In lines 13-14, the phrase “new . . . make” most directly suggests that
- (A) modern architects lack the artistic reputations of their predecessors
  - (B) the commercial treatment of culture encourages art that is mass-produced
  - (C) culture evolves out of tradition and cannot be instantly created
  - (D) historically significant venues positively influence the creative process
  - (E) new cultural centers should be constructed in collaboration with artists
12. The description in lines 20-21 (“temples . . . centers”) best serves to
- (A) scorn the architects’ commitment to historically accurate renovations
  - (B) mock the timeworn theatrical works showcased in modern cultural centers
  - (C) deprecate the appearance and character of many new theaters
  - (D) downplay the government’s efforts to support the arts
  - (E) poke good-humored fun at commercial establishments
13. As described in lines 17-23, the “practice” refers to the
- (A) commercialization of culture
  - (B) preservation of cultural treasures
  - (C) construction of shopping centers
  - (D) government funding of the arts
  - (E) distortion of theatrical works
14. In lines 27-30, the author uses the word “conventional” several times in order to
- (A) reveal the performers’ frustration with modern theaters
  - (B) disparage the present-day treatment of the arts
  - (C) parody the creative efforts of contemporary artists
  - (D) emphasize the absurdity of a purely aesthetic approach to the arts
  - (E) exaggerate the importance of tradition in the arts
15. The fifth paragraph (lines 31-39) primarily serves to
- (A) criticize the way in which cultural buildings are viewed as commodities
  - (B) assess the positive impact of the architects’ backlash against mediocrity
  - (C) contrast the business practices of real estate brokers with those of bankers
  - (D) enumerate the costs and benefits of restoring historic landmarks
  - (E) question the importance of the arts to society

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16. What does the imagery in lines 40-43 suggest?

- (A) The dawning of an enlightened artistic sensibility has stimulated support for preserving historic theaters.
- (B) The ill-conceived mandate to destroy architectural masterpieces epitomizes the censorship of creative expression.
- (C) The desire for societal status symbols drives the construction of grandiose cultural centers.
- (D) The demolition of a historic landmark is tantamount to the destruction of an invaluable cultural legacy.
- (E) The restoration of intimate old theaters will speed the demise of large new arenas.

17. In lines 49-56, the description of the building primarily serves to

- (A) convey an appreciation for the technical complexities of renovating theaters
- (B) illustrate how nineteenth-century architecture directly influenced modern building design
- (C) highlight some unique aspects of an example of fine architecture
- (D) explain why some people disdain innovative architecture
- (E) show how restoration can strip a building of its unique character

18. In lines 56-60, the author's comment about microphones implies that

- (A) the near-perfect acoustics in a new theater divert attention from the building's aesthetic flaws
- (B) audience members seated in the theater's balcony cannot fully appreciate the nuances of the performers' intonations
- (C) the performances of modern-day actors tend to be overly dependent on technology
- (D) the absence of technically sophisticated equipment has jeopardized the sound quality of performances
- (E) old theaters can remain viable because they readily accommodate the new sound technology that enhances a performance

19. Which challenge is emphasized by the author in the final paragraph (lines 73-77) ?

- (A) Designating theaters as historical landmarks
- (B) Renewing a respect for architecture
- (C) Providing opportunities for new artists
- (D) Reviving classical plays
- (E) Attracting appreciative audiences

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## SECTION 10

Time — 10 minutes

14 Questions

Turn to Section 10 (page 7) of your answer sheet to answer the questions in this section.

**Directions:** For each question in this section, select the best answer from among the choices given and fill in the corresponding circle on the answer sheet.

The following sentences test correctness and effectiveness of expression. Part of each sentence or the entire sentence is underlined; beneath each sentence are five ways of phrasing the underlined material. Choice A repeats the original phrasing; the other four choices are different. If you think the original phrasing produces a better sentence than any of the alternatives, select choice A; if not, select one of the other choices.

In making your selection, follow the requirements of standard written English; that is, pay attention to grammar, choice of words, sentence construction, and punctuation. Your selection should result in the most effective sentence—clear and precise, without awkwardness or ambiguity.

## EXAMPLE:

Laura Ingalls Wilder published her first book and she was sixty-five years old then.

- (A) and she was sixty-five years old then
- (B) when she was sixty-five
- (C) at age sixty-five years old
- (D) upon the reaching of sixty-five years
- (E) at the time when she was sixty-five

(A) ● (C) (D) (E)

1. People were unprepared for the sinking of the Titanic simply because of believing that the ship was unsinkable.
  - (A) of believing that the ship was unsinkable
  - (B) of having a belief in the ship as unsinkable
  - (C) they believed that the ship was unsinkable
  - (D) they believed the unsinkable nature of the ship
  - (E) of a belief on their part of an unsinkable ship
2. When the weather forecaster predicts a severe storm, this is when people usually rush to the supermarket to stock up on groceries.
  - (A) storm, this is when people usually rush
  - (B) storm is usually when people are rushing
  - (C) storm is why people usually rush
  - (D) storm, people usually rush
  - (E) storm, it usually rushes people
3. When, after bleak and lonely years in an English public school, he returned to India, there was suddenly perceived by himself a strong desire to write about the people and land he loved.
  - (A) there was suddenly perceived by himself
  - (B) he suddenly was perceived
  - (C) suddenly the feeling that came to him being
  - (D) he suddenly felt
  - (E) suddenly he had the feeling of
4. Curiosity about other people, about the ways they think and act, has caused Jeff to meet some fascinating characters as well as people which also really bore him.
  - (A) people which also really bore him
  - (B) he encountered really boring people
  - (C) very boring people are also met
  - (D) some very boring people
  - (E) very boring people also
5. During seasons when ticks carrying Lyme disease are most prevalent, signs could be posted to deter hikers about their venturing into tick-infested areas.
  - (A) about their venturing
  - (B) from their venturing
  - (C) from venturing
  - (D) by not venturing
  - (E) not to venture

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6. After Morris had spent ten minutes giving an answer, Claudette found he had given her only one item of information beyond what she already knew.
- (A) beyond what she already knew
  - (B) beyond what she knows already
  - (C) beyond her knowledge at the current time
  - (D) to add to what she knew already presently
  - (E) in addition to her present knowledge then
7. Although the kings and queens of England are considered Canada's monarchs, true political power lies with the prime minister, that person is elected by the Canadian citizenry.
- (A) true political power lies with the prime minister, that person is elected
  - (B) the person who holds true political power is the prime minister, which is elected
  - (C) true political power lies with the prime minister, who is elected
  - (D) the prime minister, the source of true political power, elected
  - (E) true political power is with the prime minister and is elected
8. Led by vocalist Marlena McGhee Smalls, Gullah tradition is preserved by the help of the Hallelujah Singers of South Carolina through songs and stories.
- (A) Gullah tradition is preserved by the help of the Hallelujah Singers of South Carolina through songs and stories
  - (B) the Hallelujah Singers of South Carolina help to preserve Gullah tradition through songs and stories
  - (C) the songs and stories of Gullah tradition are preserved through the Hallelujah Singers of South Carolina
  - (D) it is the Hallelujah Singers that help to preserve the songs and stories of Gullah tradition in South Carolina
  - (E) South Carolina's Gullah tradition is preserved through songs and stories by the Hallelujah Singers
9. Astronomy is the study of celestial bodies in outer space, especially their positions, dimensions, movements, and composition.
- (A) especially their positions, dimensions, movements, and composition
  - (B) and especially they are concerned with their positions, dimensions, movements, and composition
  - (C) especially studying their positions, dimensions, movements, and composition
  - (D) especially their positions, dimensions, movements, and with their composition
  - (E) with special study of their positions, dimensions, movements, and including composition
10. All the talk about controlling noise, keeping rivers clean, and planting trees have not impressed people enough to be bringing about major changes in laws and lifestyles.
- (A) have not impressed people enough to be bringing
  - (B) have not made enough of an impression on people to bring
  - (C) have not made people impressed enough to bring
  - (D) has not impressed people enough to bring
  - (E) has not made enough people impressed for bringing
11. The furnace exploded, blowing off the door, spraying greasy soot all over the basement floor, and it would rattle furniture and windowpanes throughout the building.
- (A) it would rattle
  - (B) it rattled
  - (C) causing the rattling of
  - (D) the result was to rattle
  - (E) rattling

GO ON TO THE NEXT PAGE

10



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any part of this page is illegal.



10

12. The adaptation of a novel for the screen often requires major adjustments in plot because the one art form differs from the other in having other character-revelation techniques.
- (A) because the one art form differs from the other in having other character-revelation techniques
  - (B) because the two art forms reveal character in different ways
  - (C) because of the differing ways the two may use for revealing a character
  - (D) inasmuch as there are different ways in the two art forms for character revelation
  - (E) insofar as the two differ in how to reveal character
13. The opposing opinions expressed were that the school should be torn down and, on the other hand, to keep it as a historical landmark.
- (A) were that the school should be torn down and, on the other hand, to keep it
  - (B) was that the school should be torn down or kept
  - (C) were that the school should be torn down and that it should be kept
  - (D) were about them tearing the school down and them keeping the school
  - (E) were if they should tear the school down and keeping it
14. Feeling, perhaps, that their votes do not matter, the number of young people going to the polls are becoming increasingly smaller.
- (A) the number of young people going to the polls are becoming increasingly smaller
  - (B) the number of young people going to the polls is increasingly smaller
  - (C) increasingly smaller numbers of young people are going to the polls
  - (D) young people are going to the polls in increasingly smaller numbers
  - (E) young people, who in increasingly smaller numbers are going to the polls

**STOP**

If you finish before time is called, you may check your work on this section only.  
Do not turn to any other section in the test.

# **EXHIBIT F**



## SAMPLE TEST QUESTIONS

# Step 1



**This booklet was updated June 2022.  
For Public Release**

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## USMLE STEP 1 TEST QUESTION FORMATS

### Single-Item Questions

A single patient-centered vignette is associated with one question followed by four or more response options. The response options are lettered (A, B, C, D, E). A portion of the questions require interpretation of graphic or pictorial materials. You are required to select the best answer to the question. Other options may be partially correct, but there is only ONE BEST answer. This is the traditional, most frequently used multiple-choice question format on the examination.

### Strategies for Answering Single One-Best-Answer Test Questions

The following are strategies for answering one-best-answer items:

- Read each patient vignette and question carefully. It is important to understand what is being asked.
- Try to generate an answer and then look for it in the response option list.
- Alternatively, read each response option carefully, eliminating those that are clearly incorrect.
- Of the remaining options, select the one that is most correct.
- If unsure about an answer, it is better to guess since unanswered questions are automatically counted as wrong answers.

### Example Item

A 32-year-old woman with type 1 diabetes mellitus has had progressive renal failure during the past 2 years. She has not yet started dialysis. Examination shows no abnormalities. Her hemoglobin concentration is 9 g/dL, hematocrit is 28%, and mean corpuscular volume is 94  $\mu\text{m}^3$ . A blood smear shows normochromic, normocytic cells. Which of the following is the most likely cause?

- |                                   |                                |
|-----------------------------------|--------------------------------|
| (A) Acute blood loss              | (F) Microangiopathic hemolysis |
| (B) Chronic lymphocytic leukemia  | (G) Polycythemia vera          |
| (C) Erythrocyte enzyme deficiency | (H) Sickle cell disease        |
| (D) Erythropoietin deficiency     | (I) Sideroblastic anemia       |
| (E) Immuno-hemolysis              | (J) $\beta$ -Thalassemia trait |

(Answer: D)

NOTE: Some item types that appear on the Step 1 examination are NOT depicted in the sample items provided in this booklet, eg, items with multimedia features, such as audio. Also, when additional item formats are added to the exam, notice will be provided at the USMLE website: <http://www.usmle.org>. You must monitor the website to stay informed about the types of items that occur in the exam, and you must practice with the downloadable sample test items available on the USMLE website to be fully prepared for the examination.

## INTRODUCTION TO USMLE STEP 1 SAMPLE TEST QUESTIONS

The following pages include 119 sample test questions. Most of these questions are the same as those you can install on your computer from the USMLE website. Please note that reviewing the sample questions as they appear on pages 8–51 is not a substitute for practicing with the test software. You should download and run the Step 1 tutorial and practice test items that are provided on the USMLE website well before your test date. The sample materials available on the USMLE website include an additional item with associated audio findings that does not appear in this booklet. You should become familiar with this item format that will be used in the actual examination.

Although the sample questions exemplify content on the Step 1 examination overall, they may not reflect the content coverage on individual examinations. In the actual examination, questions will be presented in random order; they will not be grouped according to specific content. The questions will be presented one at a time in a format designed for easy on-screen reading, including use of the USMLE Laboratory Values table (included here on pages 5–7) and some pictorials. Photographs, charts, and x-rays in this booklet are not of the same quality as the pictorials used in the actual examination. In addition, you will be able to adjust the brightness and contrast of pictorials on the computer screen.

To take the following sample test questions as they would be timed in the actual examination, you should allow a maximum of 1 hour for each 40-item block, and a maximum of 58 minutes, 30 seconds, for the 39-item block, for a total of 2 hours, 58 minutes, 30 seconds. Please note that the third block has 39 items instead of 40 because the multimedia item has been removed, and the recommended time to complete the block has been adjusted accordingly. Please be aware that most examinees perceive the time pressure to be greater during an actual examination. All examinees are strongly encouraged to practice with the downloadable version to become familiar with all item formats and exam timing. An answer form for recording answers is provided on page 52. An answer key is provided on page 53. In the actual examination, answers will be selected on the screen; no answer form will be provided.

USMLE LABORATORY VALUES

**SERUM**

**General Chemistry:**

Electrolytes		
Sodium (Na <sup>+</sup> )	136–146 mEq/L	136–146 mmol/L
Potassium (K <sup>+</sup> )	3.5–5.0 mEq/L	3.5–5.0 mmol/L
Chloride (Cl <sup>-</sup> )	95–105 mEq/L	95–105 mmol/L
Bicarbonate (HCO <sub>3</sub> <sup>-</sup> )	22–28 mEq/L	22–28 mmol/L
Urea nitrogen	7–18 mg/dL	2.5–6.4 mmol/L
Creatinine	0.6–1.2 mg/dL	53–106 µmol/L
Glucose	Fasting: 70–100 mg/dL Random, non-fasting: <140 mg/dL	3.8–5.6 mmol/L <7.77 mmol/L
Calcium	8.4–10.2 mg/dL	2.1–2.6 mmol/L
Magnesium (Mg <sup>2+</sup> )	1.5–2.0 mg/dL	0.75–1.0 mmol/L
Phosphorus (inorganic)	3.0–4.5 mg/dL	1.0–1.5 mmol/L

**Hepatic:**

Alanine aminotransferase (ALT)	10–40 U/L	10–40 U/L
Aspartate aminotransferase (AST)	12–38 U/L	12–38 U/L
Alkaline phosphatase	25–100 U/L	25–100 U/L
Amylase	25–125 U/L	25–125 U/L
Bilirubin, total // direct	0.1–1.0 mg/dL // 0.0–0.3 mg/dL	2–17 µmol/L // 0–5 µmol/L
Proteins, total	6.0–7.8 g/dL	60–78 g/L
Albumin	3.5–5.5 g/dL	35–55 g/L
Globulin	2.3–3.5 g/dL	23–35 g/L

**Lipids:**

Cholesterol		
Total	Normal: <200 mg/dL High: >240 mg/dL	<5.2 mmol/L >6.2 mmol/L
HDL	40–60 mg/dL	1.0–1.6 mmol/L
LDL	<160 mg/dL	<4.2 mmol/L
Triglycerides	Normal: <150 mg/dL Borderline: 151–199 mg/dL	<1.70 mmol/L 1.71–2.25 mmol/L

**Iron Studies:**

Ferritin	Male: 20–250 ng/mL Female: 10–120 ng/mL	20–250 µg/L 10–120 µg/L
Iron	Male: 65–175 µg/dL Female: 50–170 µg/dL	11.6–31.3 µmol/L 9.0–30.4 µmol/L
Total iron-binding capacity	250–400 µg/dL	44.8–71.6 µmol/L
Transferrin	200–360 mg/dL	2.0–3.6 g/L

USMLE LABORATORY VALUES (continued)

	<u>Reference Range</u>	<u>SI Reference Intervals</u>
<b>Endocrine:</b>		
Follicle-stimulating hormone	Male: 4–25 mIU/mL Female: premenopause 4–30 mIU/mL midcycle peak 10–90 mIU/mL postmenopause 40–250 mIU/mL	4–25 IU/L 4–30 IU/L 10–90 IU/L 40–250 IU/L
Luteinizing hormone	Male: 6–23 mIU/mL Female: follicular phase 5–30 mIU/mL midcycle 75–150 mIU/mL postmenopause 30–200 mIU/mL	6–23 IU/L 5–30 IU/L 75–150 IU/L 30–200 IU/L
Growth hormone - arginine stimulation	Fasting: <5 ng/mL Provocative stimuli: >7 ng/mL	<5 µg/L >7 µg/L
Prolactin (hPRL)	Male: <17 ng/mL Female: <25 ng/mL	<17 µg/L <25 µg/L
Cortisol	0800 h: 5–23 µg/dL 1600 h: 3–15 µg/dL 2000 h: <50% of 0800 h	138–635 nmol/L 82–413 nmol/L Fraction of 0800 h: <0.50
TSH	0.4–4.0 µU/mL	0.4–4.0 mIU/L
Triiodothyronine (T <sub>3</sub> ) (RIA)	100–200 ng/dL	1.5–3.1 nmol/L
Triiodothyronine (T <sub>3</sub> ) resin uptake	25%–35%	0.25–0.35
Thyroxine (T <sub>4</sub> )	5–12 µg/dL	64–155 nmol/L
Free T <sub>4</sub>	0.9–1.7 ng/dL	12.0–21.9 pmol/L
Thyroidal iodine ( <sup>123</sup> I) uptake	8%–30% of administered dose/24 h	0.08–0.30/24 h
Intact PTH	10–60 pg/mL	10–60 ng/L
17-Hydroxycorticosteroids	Male: 3.0–10.0 mg/24 h Female: 2.0–8.0 mg/24 h	8.2–27.6 µmol/24 h 5.5–22.0 µmol/24 h
17-Ketosteroids, total	Male: 8–20 mg/24 h Female: 6–15 mg/24 h	28–70 µmol/24 h 21–52 µmol/24 h
<b>Immunoglobulins:</b>		
IgA	76–390 mg/dL	0.76–3.90 g/L
IgE	0–380 IU/mL	0–380 kIU/L
IgG	650–1500 mg/dL	6.5–15.0 g/L
IgM	50–300 mg/dL	0.5–3.0 g/L
<b>Other, serum:</b>		
Creatinine clearance	Male: 97–137 mL/min Female: 88–128 mL/min	97–137 mL/min 88–128 mL/min
Creatine kinase	Male: 25–90 U/L Female: 10–70 U/L	25–90 U/L 10–70 U/L
Lactate dehydrogenase	45–200 U/L	45–200 U/L
Osmolality	275–295 mOsmol/kg H <sub>2</sub> O	275–295 mOsmol/kg H <sub>2</sub> O
Uric acid	3.0–8.2 mg/dL	0.18–0.48 mmol/L
<b>GASES, ARTERIAL BLOOD (ROOM AIR)</b>		
PO <sub>2</sub>	75–105 mm Hg	10.0–14.0 kPa
Pco <sub>2</sub>	33–45 mm Hg	4.4–5.9 kPa
pH	7.35–7.45	[H <sup>+</sup> ] 36–44 nmol/L
<b>CEREBROSPINAL FLUID</b>		
Cell count	0–5/mm <sup>3</sup>	0–5 × 10 <sup>6</sup> /L
Chloride	118–132 mEq/L	118–132 mmol/L
Gamma globulin	3%–12% total proteins	0.03–0.12
Glucose	40–70 mg/dL	2.2–3.9 mmol/L
Pressure	70–180 mm H <sub>2</sub> O	70–180 mm H <sub>2</sub> O
Proteins, total	<40 mg/dL	<0.40 g/L

Continued on Next Page

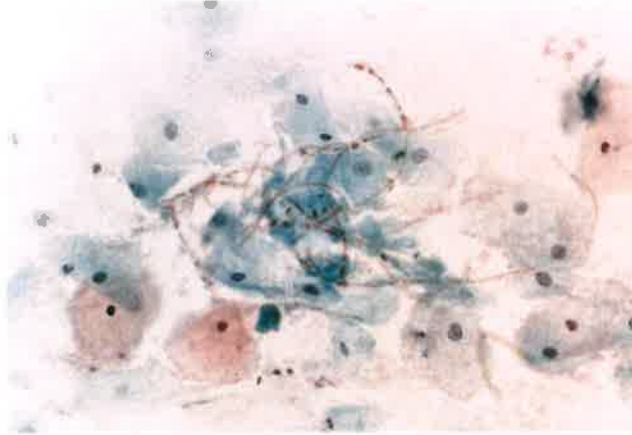
USMLE LABORATORY VALUES (continued)

	<u>Reference Range</u>	<u>SI Reference Intervals</u>
<b>HEMATOLOGIC</b>		
<b><i>Complete Blood Count:</i></b>		
Hematocrit	Male: 41%–53% Female: 36%–46%	0.41–0.53 0.36–0.46
Hemoglobin, blood	Male: 13.5–17.5 g/dL Female: 12.0–16.0 g/dL	135–175 g/L 120–160 g/L
Mean corpuscular hemoglobin (MCH)	25–35 pg/cell	0.39–0.54 fmol/cell
Mean corpuscular hemoglobin conc. (MCHC)	31%–36% Hb/cell	4.8–5.6 mmol Hb/L
Mean corpuscular volume (MCV)	80–100 $\mu\text{m}^3$	80–100 fL
Volume		
Plasma	Male: 25–43 mL/kg Female: 28–45 mL/kg	0.025–0.043 L/kg 0.028–0.045 L/kg
Red cell	Male: 20–36 mL/kg Female: 19–31 mL/kg	0.020–0.036 L/kg 0.019–0.031 L/kg
Leukocyte count (WBC)	4500–11,000/mm <sup>3</sup>	4.5–11.0 $\times 10^9/\text{L}$
Neutrophils, segmented	54%–62%	0.54–0.62
Neutrophils, bands	3%–5%	0.03–0.05
Lymphocytes	25%–33%	0.25–0.33
Monocytes	3%–7%	0.03–0.07
Eosinophils	1%–3%	0.01–0.03
Basophils	0%–0.75%	0.00–0.0075
Platelet count	150,000–400,000/mm <sup>3</sup>	150–400 $\times 10^9/\text{L}$
<b><i>Coagulation:</i></b>		
Partial thromboplastin time (PTT) (activated)	25–40 seconds	25–40 seconds
Prothrombin time (PT)	11–15 seconds	11–15 seconds
D-Dimer	$\leq 250$ ng/mL	$\leq 1.4$ nmol/L
<b><i>Other, Hematologic:</i></b>		
Reticulocyte count	0.5%–1.5%	0.005–0.015
Erythrocyte count (RBC)	Male: 4.3–5.9 million/mm <sup>3</sup> Female: 3.5–5.5 million/mm <sup>3</sup>	4.3–5.9 $\times 10^{12}/\text{L}$ 3.5–5.5 $\times 10^{12}/\text{L}$
Erythrocyte sedimentation rate (Westergren)	Male: 0–15 mm/h Female: 0–20 mm/h	0–15 mm/h 0–20 mm/h
CD4+ T-lymphocyte count	$\geq 500/\text{mm}^3$	$\geq 0.5 \times 10^9/\text{L}$
Troponin I	$\leq 0.04$ ng/mL	$\leq 0.04$ $\mu\text{g}/\text{L}$
<b><i>Endocrine:</i></b>		
Hemoglobin A <sub>1c</sub>	$\leq 6\%$	$\leq 42$ mmol/mol
<b>URINE</b>		
Calcium	100–300 mg/24 h	2.5–7.5 mmol/24 h
Osmolality	50–1200 mOsmol/kg H <sub>2</sub> O	50–1200 mOsmol/kg H <sub>2</sub> O
Oxalate	8–40 $\mu\text{g}/\text{mL}$	90–445 $\mu\text{mol}/\text{L}$
Proteins, total	$< 150$ mg/24 h	$< 0.15$ g/24 h
<b>BODY MASS INDEX (BMI)</b>		
	Adult: 19–25 kg/m <sup>2</sup>	

USMLE STEP 1 SAMPLE TEST QUESTIONS

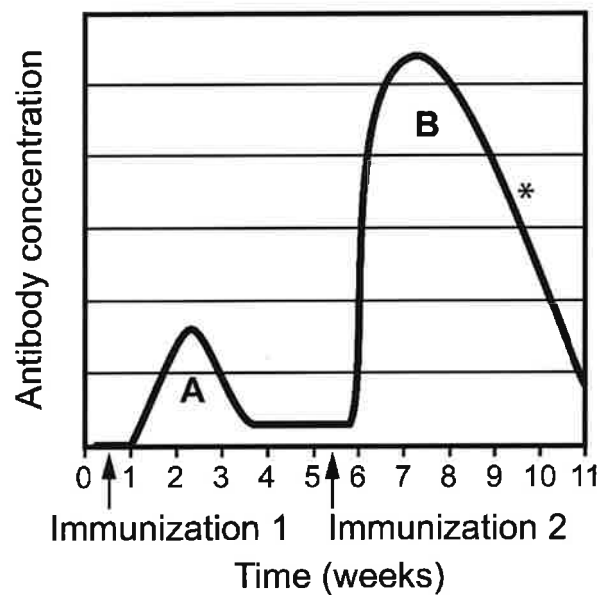
BLOCK 1, ITEMS 1-40

1. Serum LDL-cholesterol concentrations are measured in blood samples collected from 25 healthy volunteers. The data follow a normal distribution. The mean and standard deviation for this group are 130 mg/dL and 25 mg/dL, respectively. The standard error of the mean is 5.0. With a 95% confidence level, the true mean for the population from which this sample was drawn falls within which of the following ranges (in mg/dL)?
  - (A) 105-155
  - (B) 120-140
  - (C) 125-135
  - (D) 128-132
  - (E) 129-131
  
2. A 48-year-old man dies suddenly of a cardiac arrhythmia. Six weeks ago, he was resuscitated from a cardiac arrest caused by coronary artery disease and developed oliguric renal failure. Five weeks ago (1 week after being resuscitated), his serum urea nitrogen (BUN) concentration was 40 mg/dL, his serum creatinine concentration was 3.5 mg/dL, and his urine contained granular casts. Four weeks ago, his oliguria resolved, and his BUN and serum creatinine concentrations returned to normal. Examination of his kidneys at autopsy is most likely to show which of the following?
  - (A) Acute inflammation
  - (B) Fibrinous exudate
  - (C) Fibrous scar
  - (D) Granulation tissue
  - (E) Normal kidney
  
3. In a sample of 100 individuals, the mean leukocyte count is  $7500/\text{mm}^3$ , with a standard deviation of  $1000/\text{mm}^3$ . If the leukocyte counts in this population follow a normal (gaussian) distribution, approximately 50% of individuals will have which of the following total leukocyte counts?
  - (A)  $5500\text{--}9500/\text{mm}^3$
  - (B)  $<6500/\text{mm}^3$  or  $>8500/\text{mm}^3$
  - (C)  $6500\text{--}8500/\text{mm}^3$
  - (D)  $<7500/\text{mm}^3$
  - (E)  $>9500/\text{mm}^3$



4. A 55-year-old woman comes to the clinic because of a 2-month history of increasingly severe vaginal pain and itching during sexual intercourse. She avoids intercourse with her husband because of the symptoms. She has been in a monogamous relationship with her husband for the past 25 years. She has type 2 diabetes mellitus. Her vital signs are within normal limits. Pelvic examination shows edematous and erythematous vaginal mucosa with white discharge. A photomicrograph of a vaginal smear is shown. Which of the following is the most likely causal infectious agent?
- (A) *Candida albicans*
  - (B) *Chlamydia trachomatis*
  - (C) Herpes simplex virus
  - (D) Human papillomavirus
  - (E) *Trichomonas vaginalis*
- 
5. A 39-year-old man comes to the physician because of a 6-month history of progressive shortness of breath. He has had a cough productive of white sputum for 2 years. He smoked 1 pack of cigarettes daily for 16 years but quit 10 years ago. He is in mild respiratory distress with pursed lips and a barrel chest; he is using the accessory muscles of respiration. Breath sounds are distant and crackles are present in the lower lung fields bilaterally. Pulmonary function tests show a decreased FEV<sub>1</sub>:FVC ratio, increased residual volume, and decreased diffusion capacity. An x-ray of the chest shows hyperinflation and hypertranslucency of the lower lobes of both lungs. Which of the following is the most likely diagnosis?
- (A) Asthma
  - (B) Bronchiectasis
  - (C) Chronic pulmonary fibrosis
  - (D) Cystic fibrosis
  - (E) Emphysema

6. A previously healthy 33-year-old woman is brought to the emergency department by the Secret Service for stalking the president of the USA for 2 months. She claims to be married to the president's twin brother and states that the president just had his twin kidnapped to avoid competition. She speaks rapidly and is difficult to interrupt. Her associations are often loose. She says, "I haven't slept for days, but I won't even try to sleep until my husband is rescued. God has been instructing me to take over the White House. I can't wait to be reunited with my husband. I hear his voice telling me what to do." When asked about drug use, she says she uses only natural substances. She refuses to permit blood or urine tests, saying, "I don't have time to wait for the results." Which of the following is the most likely diagnosis?
- (A) Bipolar disorder, manic, with psychotic features
  - (B) Brief psychotic disorder
  - (C) Delusional disorder
  - (D) Psychotic disorder due to general medical condition
  - (E) Schizophrenia



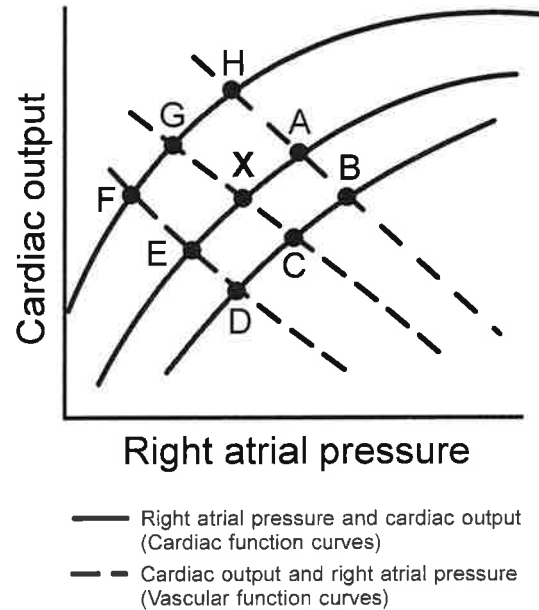
7. During an experiment, a mouse is vaccinated with live attenuated bacteria at two different times. The results following immunization are shown in the graph. The subject's serum total antibody concentration (Y-axis) was measured at various time points (X-axis). The response to the first immunization is indicated by Peak A, while that of the second immunization with the same bacterial antigen is indicated by Peak B. The phase of the immune response represented by the asterisk is most likely the direct result of which of the following?
- (A) Antigen recognition
  - (B) Apoptosis of activated lymphocytes
  - (C) B-lymphocyte expansion
  - (D) Macrophage phagocytosis
  - (E) T-lymphocyte activation



8. A 53-year-old man comes to the physician because of a dry scaly rash on his body for the past year. He has had a 15-kg (33-lb) weight loss during the past year. He is 178 cm (5 ft 10 in) tall and now weighs 54 kg (120 lb); BMI is 17 kg/m<sup>2</sup>. His stools have a large volume and float. Which of the following nutrient deficiencies is most likely?
- (A) Magnesium
  - (B) Vitamin A
  - (C) Vitamin B<sub>12</sub> (cobalamin)
  - (D) Vitamin C
  - (E) Zinc
9. In screening for prostate cancer, the current serum prostate-specific antigen concentration at which biopsy is recommended is 4.1 ng/mL. If the threshold for recommending a biopsy procedure were lowered to 2.0 ng/mL, which of the following changes would occur to the positive and negative predictive values of the test?

	Positive Predictive Value	Negative Predictive Value
(A)	↑	↑
(B)	↑	no change
(C)	↑	↓
(D)	No change	↑
(E)	No change	no change
(F)	No change	↓
(G)	↓	↑
(H)	↓	no change
(I)	↓	↓

10. In informing a couple that their newborn has Down syndrome, there is a specific, relatively limited amount of information that the consulting physician should give immediately. The rest can be discussed at a later time. Which of the following best explains the purpose of using this approach to disclosure?
- (A) Allowing the couple's primary care physician to discuss most of the information with them
  - (B) Allowing the parents time to tell other family members
  - (C) Delaying parental distress until the information is completely disclosed
  - (D) Disclosing the most important information so that it can be understood as fully as possible
  - (E) Influencing the parents' course of action about what is medically most appropriate

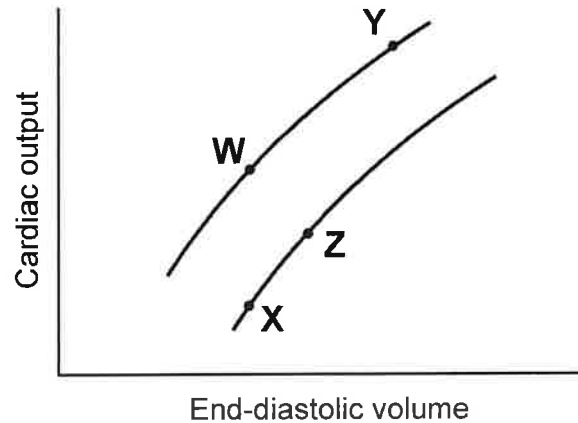


11. A 25-year-old man volunteers to participate in a study of exercise. The solid curves in the graph show the relationship between right atrial pressure and cardiac output (cardiac function curves). The dashed lines show the relationship between cardiac output and right atrial pressure (vascular function curves). Point X is the pre-exercise equilibrium point. Which of the following labeled areas is the most likely new cardiac and vascular equilibrium point during exercise in this subject?

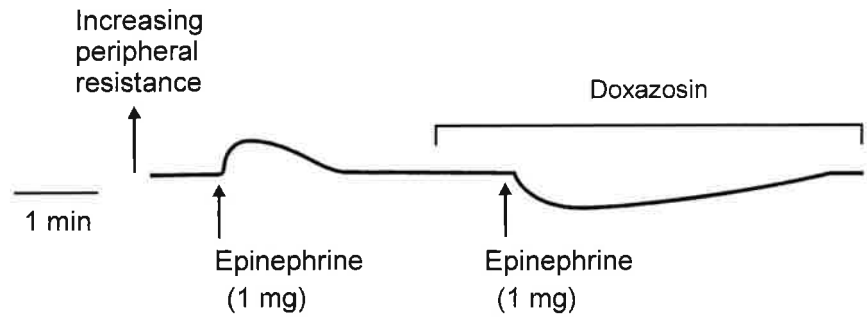
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12. A 62-year-old man comes to the physician because of a 6-month history of urinary hesitancy and dribbling after urination. He has to urinate two to three times nightly. Physical examination shows a diffusely enlarged, firm, and nontender prostate. Which of the following is most likely to have contributed to the development of this patient's condition?
  - (A) Activation of the  $\alpha_1$ -adrenergic receptor
  - (B) Conversion of testosterone to dihydrotestosterone
  - (C) Conversion of testosterone to estradiol
  - (D) Inhibition of the  $\alpha_1$ -adrenergic receptor
  - (E) Production of prostate-specific antigen
13. An 18-year-old woman with sickle cell disease is brought to the emergency department by her parents because of a 2-hour history of severe abdominal pain and nausea. Her parents say that she had a cheeseburger, milk shake, and chocolate bar for lunch. Her temperature is 37°C (98.6°F). Physical examination shows tenderness over the right upper quadrant of the abdomen, radiating to the right shoulder. Ultrasonography of the right upper quadrant of the abdomen shows gallstones. Which of the following is the most likely underlying cause of this patient's current condition?
  - (A) Decreased hepatic secretion of lecithin
  - (B) Decreased reabsorption of bile salts
  - (C) High ratio of cholesterol to bile acids in bile
  - (D) Infestation with parasites secreting  $\beta$ -glucuronidase
  - (E) Overload of unconjugated bilirubin

14. A 45-year-old man is brought to the emergency department 30 minutes after the sudden onset of crushing chest pain. His father, maternal aunt, and paternal uncle all died of myocardial infarctions under the age of 50 years. Physical examination shows tendinous xanthomas on the hands and thickened Achilles tendons. Serum lipid studies show a total cholesterol concentration of 410 mg/dL, HDL-cholesterol concentration of 30 mg/dL, and triglyceride concentration of 140 mg/dL. The diagnosis of myocardial infarction is made. This patient most likely has a deficiency of which of the following?
- (A) Apo B48
  - (B) Apo C
  - (C) HMG-CoA reductase activity
  - (D) LDL receptor
  - (E) Lipoprotein lipase activity
15. An experimental animal is created in which the germinal centers of the reactive lymph nodes show shrinkage of cells, cytoplasmic budding, no adjacent inflammation, and intact plasma membranes. These cellular findings are most likely caused by which of the following mechanisms?
- (A) Caspase activation
  - (B) Decreased cytochrome *c* concentration
  - (C) Decreased intracellular  $\text{Ca}^{2+}$  concentration
  - (D) Increased glutathione peroxidase activity
  - (E) Increased lysosomal enzyme activity
16. Investigators conduct a study that evaluates the effect of finasteride on the incidence of prostate cancer in 500 patients. The investigators recruit an additional 1000 patients for the study. Which of the following effects will this have on the research study?
- (A) Greater chance of a Type I error
  - (B) Greater chance of a Type II error
  - (C) Less chance of a Type I error
  - (D) Less chance of a Type II error
  - (E) Impossible to predict
17. A 76-year-old man dies of a massive cerebral infarction shortly after admission to the hospital. During the past 10 years, he has had several smaller cerebral infarctions and two transient ischemic attacks. Examination of a cerebral cortex specimen obtained at autopsy shows extensive gliosis. This finding is most likely caused by the growth and proliferation of which of the following?
- (A) Astrocytes
  - (B) Ependymal cells
  - (C) Fibroblasts
  - (D) Microglial cells
  - (E) Oligodendrocytes



18. A 65-year-old woman is brought to the emergency department because of a 10-minute history of chest tightness and severe pain of her left arm. Physical examination shows jugular venous distention. Crackles are heard over the lung fields. An ECG shows ST-segment elevation greater than 1 mm in leads  $V_4$  through  $V_6$  and new Q waves. Serum studies show an increased troponin I concentration. Which of the following labeled points in the graph best represents the changes in cardiac function that occurred during the first 10 seconds after the onset of pain in this patient?
- (A)  $W \rightarrow X$
  - (B)  $W \rightarrow Y$
  - (C)  $W \rightarrow Z$
  - (D)  $X \rightarrow W$
  - (E)  $X \rightarrow Y$
  - (F)  $X \rightarrow Z$
  - (G)  $Z \rightarrow W$
  - (H)  $Z \rightarrow X$
  - (I)  $Z \rightarrow Y$
- 
19. A previously healthy 52-year-old woman comes to the physician because of a 2-month history of fatigue, constipation, and frequent urination. Her temperature is  $37.1^{\circ}\text{C}$  ( $98.8^{\circ}\text{F}$ ), pulse is 80/min, respirations are 14/min, and blood pressure is 140/90 mm Hg. Diffuse crackles are heard bilaterally. Her serum calcium concentration is 11.1 mg/dL, and serum parathyroid hormone concentration is decreased. A chest x-ray shows bilateral hilar lymphadenopathy and interstitial infiltrates. Which of the following is the most likely cause of this patient's hypercalcemia?
- (A) Calcitriol production by activated macrophages
  - (B) Local resorption of bone by metastases
  - (C) Parathyroid hormone-related peptide secretion
  - (D) Secretion of parathyroid hormone
  - (E) Secretion of thyroid-stimulating hormone
20. A 66-year-old man who was recently diagnosed with Parkinson disease comes to the physician for a follow-up examination. Carbidopa-levodopa therapy was initiated at the time of diagnosis. The patient tells the physician that he still has episodes during which he "freezes." He has a clumsy gait, and there is rigidity of his upper extremities and hands. An adjunct therapy designed to inhibit which of the following enzymes is most likely indicated in this patient?
- (A) Aromatic L-amino acid decarboxylase
  - (B) Dopamine  $\beta$ -hydroxylase
  - (C) Monoamine oxidase B
  - (D) Phenylethanolamine *N*-methyltransferase
  - (E) Tyrosine hydroxylase



21. A study is conducted to assess the effects of epinephrine on total peripheral resistance. An anesthetized experimental animal is injected with a bolus of the drug in both the presence and absence of doxazosin. The results are shown in the graph. Which of the following best represents the signal transduction pathways used by epinephrine to produce these results?

	Epinephrine Without Doxazosin	Epinephrine With Doxazosin
(A)	Increased cAMP	decreased cAMP
(B)	Increased cAMP	decreased cGMP
(C)	Increased cGMP	decreased cAMP
(D)	Increased cGMP	decreased phosphoinositide turnover
(E)	Increased phosphoinositide turnover	decreased cAMP
(F)	Increased phosphoinositide turnover	increased cAMP

22. A 46-year-old woman comes to the physician because of a 3-day history of intermittent pain with urination and increased urinary frequency. She says that she had one similar episode during the past 6 months. She also has had irregular menses, and her last menstrual period occurred 2 months ago. She has not had fever, nausea, vomiting, or blood in her urine. She is sexually active with one male partner. Physical examination shows no abnormalities. Urinalysis shows:

RBC	3–5/hpf
WBC	10–20/hpf
Nitrites	positive
Leukocyte esterase	positive
Bacteria	positive

Which of the following is the strongest predisposing risk factor for the development of this patient's condition?

- (A) Leiomyomata uteri
- (B) Perimenopause
- (C) Pregnancy
- (D) Sexual intercourse

23. A 28-year-old man comes to the physician because of a 2-month history of a rash on his wrists and hands. He is a first-year mortuary science student. He also works on his grandfather's farm each weekend. His hobbies include raising homing pigeons and repairing vintage motorcycles. He recently changed to a different type of laundry detergent to save money. Physical examination shows a diffuse erythematous rash involving both hands up to the wrist creases. The rash does not extend over any other parts of the body. Which of the following is the most likely cause of this patient's rash?

- (A) Change in laundry detergent
- (B) Exposure to chemicals during motorcycle repair
- (C) Handling pigeons
- (D) Pesticide exposure
- (E) Use of latex gloves

24. A 10-year-old boy is brought to the emergency department in the middle of summer because of fever, headache, and photophobia. Several of his camp mates have had a similar illness. Physical examination shows mild nuchal rigidity. A lumbar puncture is performed. Laboratory studies show:

Serum glucose	90 mg/dL
Cerebrospinal fluid	
Pressure, opening	50 mm H <sub>2</sub> O
Glucose	65 mg/dL
Total protein	70 mg/dL
Leukocyte count	43/mm <sup>3</sup> (95% lymphocytes)

Which of the following infectious agents is the most likely cause of these findings?

- (A) Adenovirus
- (B) Enterovirus
- (C) Herpes simplex virus
- (D) *Neisseria meningitidis*
- (E) *Streptococcus pneumoniae*

25. A healthy 30-year-old woman participates in a study of the relationship between cardiovascular function and posture. Placed in a room with a comfortable temperature (72°F) and humidity (40%), she moves from a standing to a supine position. Which of the following sets of changes is most likely in the reflex control of this woman's cardiovascular system?

	Carotid Sinus Baroreceptor Activity	Atrial Stretch Receptor Activity	Vagal Efferent Activity to the Heart
(A)	↑	↑	↑
(B)	↑	↑	↓
(C)	↑	↓	↑
(D)	↑	↓	↓
(E)	↓	↑	↑
(F)	↓	↑	↓
(G)	↓	↓	↑
(H)	↓	↓	↓

26. A 31-year-old woman with a 5-year history of fatigue comes to the physician for an initial visit. She has seen four other physicians for the same condition within the past 6 months, but no abnormalities were found. She gives the physician a large folder that contains her medical records. She says, "I can barely get out of bed most mornings, but nobody can figure out why because all of my tests turn out normal. I really think I have chronic fatigue syndrome. What do you know about this condition?" The physician has not treated any patient with chronic fatigue syndrome before. Which of the following initial statements by the physician is most appropriate to establish rapport with this patient?
- (A) "From the size of the folder you brought, it looks like you've had very thorough examinations in the past."
  - (B) "I don't have much experience with chronic fatigue syndrome, but I'm committed to learning as much as I can about it."
  - (C) "I'm not familiar with chronic fatigue syndrome, except that many physicians don't think it's a real disease."
  - (D) "Let's start over from scratch. We'll need to repeat complete testing."
  - (E) "When nothing abnormal is found during thorough examinations and laboratory studies, there is often an underlying psychological cause of the symptoms."
27. A 3-week-old girl delivered at term with no complications is brought to the physician by her mother because of a 1-week history of yellow eyes and skin, tan-colored stools, and dark brown urine. The newborn has been breast-feeding without difficulty. She is alert and appears to be in no distress. She is at the 50th percentile for length and weight. Physical examination shows scleral icterus and jaundice. There is mild hepatomegaly; the spleen is not palpable. Laboratory studies show:

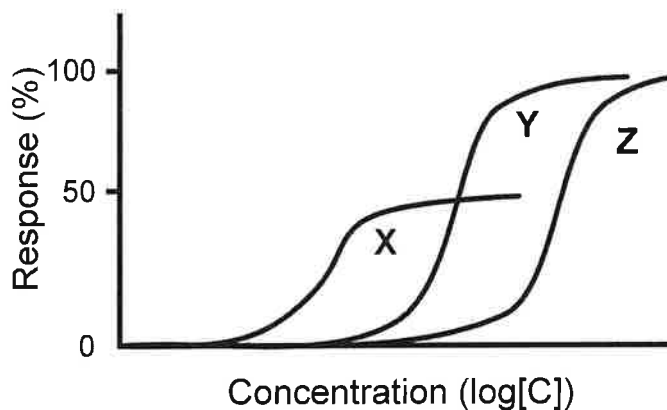
Hemoglobin	14.4 g/dL
Hematocrit	43%
Leukocyte count	8000/mm <sup>3</sup>
Serum	
Albumin	3.5 g/dL
Bilirubin, total	14 mg/dL
Direct	12.5 mg/dL
AST	50 U/L
ALT	45 U/L

Which of the following is the most likely diagnosis?

- (A) Biliary atresia
  - (B) Crigler-Najjar syndrome, type I
  - (C) Gilbert syndrome
  - (D) Hemolytic disease of the newborn
  - (E) Physiologic jaundice
- 
28. A 65-year-old woman comes to the physician for a follow-up examination after blood pressure measurements were 175/105 mm Hg and 185/110 mm Hg 1 and 3 weeks ago, respectively. She has well-controlled type 2 diabetes mellitus. Her blood pressure now is 175/110 mm Hg. Physical examination shows no other abnormalities. Antihypertensive therapy is started, but her blood pressure remains elevated at her next visit 3 weeks later. Laboratory studies show increased plasma renin activity; the erythrocyte sedimentation rate and serum electrolytes are within the reference ranges. Angiography shows a high-grade stenosis of the proximal right renal artery; the left renal artery appears normal. Which of the following is the most likely diagnosis?
- (A) Atherosclerosis
  - (B) Congenital renal artery hypoplasia
  - (C) Fibromuscular dysplasia
  - (D) Takayasu arteritis
  - (E) Temporal arteritis

29. Results of a study that examined the impact of risk factors on cardiovascular health are being evaluated. In the study, serum LDL-cholesterol (LDL) concentration is found to have a correlation of 0.6 with serum high-sensitivity C-reactive protein (hs-CRP) concentration. Which of the following statements best describes the relationship between LDL concentration and hs-CRP concentration based on this finding?

- (A) Higher LDL concentrations are associated with higher hs-CRP concentrations
- (B) Higher LDL concentrations are associated with lower hs-CRP concentrations
- (C) Higher LDL concentrations cause higher hs-CRP concentrations
- (D) Higher LDL concentrations cause lower hs-CRP concentrations



30. A pharmaceutical company is developing a new bronchodilator agent. The graph shows concentration-response curves for three investigational drugs (Drugs X, Y, and Z), describing their effect on bronchial smooth muscle relaxation. Based on these data, which of the following best describes the relationship among these three agents?

- (A) Drug X is more potent than Drugs Y or Z
- (B) Drug X has greater efficacy than Drugs Y or Z
- (C) Drug Y is more potent than Drugs X or Z
- (D) Drug Y has greater efficacy than Drugs X or Z
- (E) Drug Z is more potent than Drugs X or Y
- (F) Drug Z has greater efficacy than Drugs X or Y



31. A 72-year-old man comes to the physician for a health maintenance examination. He has no personal or family history of major medical illnesses. He has never smoked cigarettes. Pulse oximetry on room air shows an oxygen saturation of 98%. Physical examination shows plethoric skin and splenomegaly. Laboratory studies show:

Hemoglobin	21.1 g/dL
Hematocrit	61%
Leukocyte count	15,000/mm <sup>3</sup>
Segmented neutrophils	68%
Basophils	4%
Lymphocytes	28%
Platelet count	501,000/mm <sup>3</sup>
Leukocyte alkaline phosphatase	increased

A peripheral blood smear shows occasional giant platelets. The primary hematologic defect in this patient most likely occurred in which of the following cells?

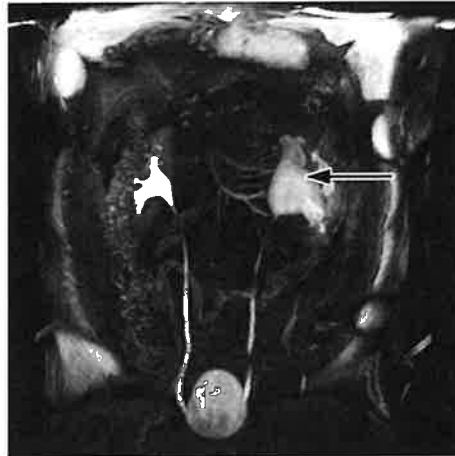
- (A) Erythroid progenitor
  - (B) Hematopoietic stem
  - (C) Lymphatic progenitor
  - (D) Megakaryocyte progenitor
  - (E) Pluripotent stem
- 



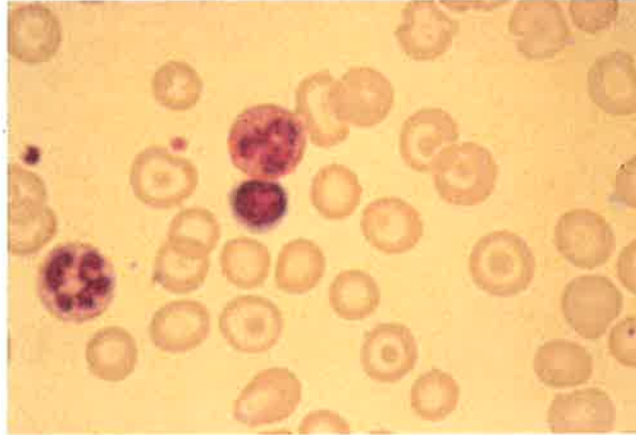
32. A 45-year-old man comes to the physician because of a 10-year history of heartburn that occurs after he eats late at night or consumes spicy food. He has had no weight loss or difficulty swallowing. He takes over-the-counter antacids as needed, but they relieve his discomfort only temporarily. Physical examination shows no abnormalities. An endoscopy is done. The distal esophagus is shown in the photograph. Which of the following is the most likely cause of this patient's symptoms?

- (A) Defect in secretin production
  - (B) Excessive gastrin production
  - (C) Excessive transient lower esophageal relaxations
  - (D) Failure of primary esophageal peristalsis
  - (E) Failure of saliva production
-

33. A 21-year-old man comes to the emergency department in the winter because of headache, nausea, and dizziness for 4 hours. He has not had fever, chills, or shortness of breath. He has no history of major medical illness. He lives in a basement apartment of a three-story house. He smokes 1½ packs of cigarettes daily. Physical examination shows no abnormalities. It is most appropriate for the physician to ask the patient for more information about which of the following historical factors?
- (A) Occupational exposure
  - (B) Substance use
  - (C) Travel
  - (D) Type of home heating
  - (E) Use of over-the-counter medication



34. A 56-year-old woman comes to the physician because of a 2-year history of recurrent urinary tract infections accompanied by left flank pain. Physical examination shows no abnormalities. Renal ultrasonography shows left-sided hydronephrosis. A T2-weighted coronal MRI of the abdomen is shown; the arrow indicates the hydronephrosis. The left renal collecting system is most likely obstructed at which of the following anatomic locations in this patient?
- (A) Bladder neck
  - (B) Mid ureter
  - (C) Renal calyx
  - (D) Ureteropelvic junction
  - (E) Ureterovesical junction
- 
35. A 25-year-old woman comes to the physician because of a long history of pain with menses. The pain occurs on the first day of her 5-day menstrual period and lasts all day. She rates the pain as 10 on a 10-point scale. The most appropriate initial pharmacotherapy to relieve this patient's pain has which of the following mechanisms of action?
- (A) Inhibition of estrogen synthesis
  - (B) Inhibition of 11β-hydroxylase activity
  - (C) Inhibition of prostaglandin synthesis
  - (D) Stimulation of follicle-stimulating hormone synthesis
  - (E) Stimulation of luteinizing hormone synthesis



36. A 35-year-old man is brought to the emergency department 30 minutes after he sustained a cut on his hand while loading cargo at his job. He lives alone and takes most of his meals at a local restaurant. He eats mostly snack foods at the bar and fast food. He drinks four to six 12-oz beers daily and double that amount on weekends. He takes no medications. Physical examination shows a 3-cm laceration on the right hand that is bleeding steadily. Laboratory studies show a hemoglobin concentration of 11 g/dL, leukocyte count of 4000/mm<sup>3</sup>, and platelet count of 150,000/mm<sup>3</sup>. A photomicrograph of a peripheral blood smear is shown. A deficiency of which of the following is the most likely cause of this patient's anemia?
- (A) Folic acid
  - (B) Glucose-6-phosphate dehydrogenase
  - (C) Iron
  - (D) Vitamin B<sub>1</sub> (thiamine)
  - (E) Vitamin B<sub>6</sub> (pyridoxine)
- 
37. A 3800-g (8-lb 6-oz) newborn is delivered vaginally at 39 weeks' gestation after an uncomplicated pregnancy. Apgar scores are 9 and 9 at 1 and 5 minutes, respectively. The newborn is crying, has pink skin, and appears vigorous. Physical examination shows a vagina and also a structure that appears to be a penis, with the urethra located at the base near the opening of the vagina. Chromosomal analysis is ordered. Which of the following is the most likely cause of the intersex findings in this newborn if the karyotype is found to be 46,XX?
- (A) 17 $\alpha$ -Hydroxyprogesterone deficiency
  - (B) Increased concentration of müllerian-inhibiting substance
  - (C) Maternal androgen exposure
  - (D) Presence of the sex-determining region Y gene
  - (E) 5 $\alpha$ -Reductase deficiency
38. A 65-year-old man is admitted to the hospital because of a 12-hour history of chest pain. Physical examination shows no abnormalities. Serum studies show an increased troponin I concentration. The diagnosis of myocardial infarction is made. It is suspected that this patient's condition deteriorated as a result of ischemia-reperfusion injury. The increased serum troponin I concentration in this patient most likely occurred as a result of which of the following processes?
- (A) Increased enzyme secretion
  - (B) Increased enzyme synthesis
  - (C) Karyolysis
  - (D) Lysis of the endoplasmic reticulum
  - (E) Lysis of the plasma membrane
  - (F) Mitochondrial swelling

39. A randomized clinical trial is conducted to compare wound healing and cosmetic differences between two surgical procedures for closing skin wounds following cesarean delivery. A total of 1000 women undergoing cesarean delivery during a 6-month period are enrolled in the study, which was 85% of the total number of patients undergoing the procedure. The results show a wound infection rate of 12 cases per 1000 women for Procedure A and 18 cases per 1000 women for Procedure B. Which of the following is the best estimate of the absolute risk reduction for wound infection following Procedure A compared with Procedure B?
- (A)  $(18/1000) - (12/1000)$
  - (B)  $0.85 \times (12/1000)$
  - (C)  $0.85 \times (18/1000)$
  - (D)  $[0.85 \times (18/1000 - 12/1000)]$
  - (E)  $[(1.2/100) - (1.8/100)] / (1.8/100)$



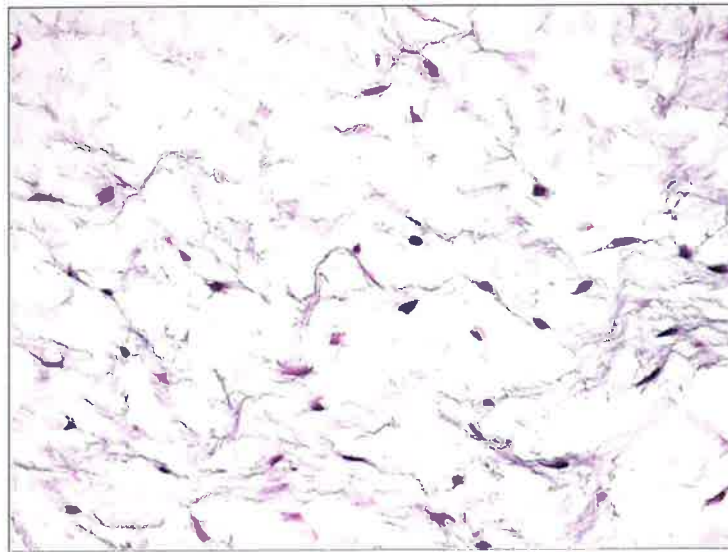
40. A 22-year-old man is brought to the emergency department 15 minutes after diving off a pier into shallow water, striking his forehead on the bottom of the pond. He says that he felt immediate pain in his neck and then lost all ability to move or feel his legs. Physical examination shows that all muscle function above the level of the injury is preserved. A lateral x-ray of the cervical spine is shown. Which of the following functions is most likely spared in this patient?
- (A) Elbow extension
  - (B) Elbow flexion
  - (C) Finger abduction
  - (D) Thumb abduction
  - (E) Wrist flexion
-

USMLE STEP 1 SAMPLE TEST QUESTIONS

BLOCK 2, ITEMS 41-80

41. A 4-year-old girl with type 1 diabetes mellitus is brought to the emergency department by her father because of a 4-hour episode of restlessness, sweating, and confusion that occurred during the night. Yesterday, he allowed her to eat cupcakes and cotton candy at a county fair. At her bedtime that evening, he increased her dose of subcutaneous intermediate-acting and long-acting insulin. Her symptoms began 6 hours later, then resolved spontaneously. After being informed this morning of this nighttime episode, the mother insisted the father bring the patient to the hospital. On arrival, the patient is alert. Her vital signs are within normal limits. Examination shows no abnormalities. Her fingerstick blood glucose concentration is 72 mg/dL. Urinalysis is negative for glucose and ketones. Which of the following is the most likely explanation for this patient's nighttime symptoms?

- (A) Hyperglycemia caused by increased glucose consumption
- (B) Hyperglycemia caused by increased glycogen metabolism
- (C) Hyperglycemia caused by insufficient exogenous insulin
- (D) Hypoglycemia caused by excess exogenous insulin
- (E) Hypoglycemia caused by excessive renal glucose loss
- (F) Hypoglycemia caused by increased glucagon secretion
- (G) Nightmare disorder
- (H) Sleep terror disorder



42. A previously healthy 65-year-old woman comes to the physician because of several episodes of fainting during the past 2 months. Each episode lasted several minutes. Her pulse is 82/min, respirations are 20/min, and blood pressure is 135/87 mm Hg. Cardiac examination shows S<sub>3</sub> and S<sub>4</sub>. Echocardiography shows a pedunculated intracardiac mass. The lesion is resected. A photomicrograph of the resected lesion is shown. This lesion was most likely obtained from which of the following locations?

- (A) Interventricular septum
- (B) Left atrium
- (C) Left ventricle
- (D) Right atrium
- (E) Right ventricle

43. A male newborn is delivered at term to a 28-year-old primigravid woman. Physical examination shows a broad, flat nose; low-set ears; a receding chin; prominent infraorbital folds; and bilateral abdominal masses. The newborn develops cyanosis, difficulty breathing, and polyuria and dies 24 hours after birth. At autopsy, examination shows pulmonary hypoplasia and enlarged, polycystic kidneys. Genetic testing shows two copies of a gene having a pathogenic mutation with a disease incidence rate in the general population of 1 in 10,000. Which of the following best describes the mutation occurrence rate for this newborn's disease?
- (A) 1/100
  - (B) 1/400
  - (C) 1/1000
  - (D) 1/4000
  - (E) 1/10,000



44. A 75-year-old woman comes to the physician because of a 3-year history of pain in her wrists and hands. She says that the pain has become more severe during the past 3 months. She has difficulty buttoning her coat because of the pain. Physical examination shows the findings in the photograph. Which of the following additional hand findings is most likely in this patient?
- (A) Cortical thinning
  - (B) Degenerative changes of the cartilage
  - (C) Inflammation of digital tendons
  - (D) Neutrophilic infiltration of the synovium
  - (E) Thickening of the synovium with pannus
- 
45. A previously healthy 64-year-old man is brought to the emergency department 3 hours after the sudden onset of severe flank pain. He has no history of similar pain or serious illness. He takes no medications. He appears to be in distress. His pulse is 100/min, and blood pressure is 168/92 mm Hg. Physical examination shows a soft abdomen with left-sided tenderness. Urinalysis shows microscopic hematuria. A CT scan of the abdomen shows a small ureteric calculus. Analgesic therapy is initiated and the pain resolves 1 hour later. The urine is then strained and a uric acid calculus is found. Which of the following processes is most likely impaired in this patient?
- (A) Bile salt metabolism
  - (B) Cholesterol metabolism
  - (C) Cytochrome P450 activity
  - (D) Purine metabolism
  - (E) Urea cycle



46. A 32-year-old woman with hypothyroidism comes to the physician because of a 6-week history of cold intolerance, constipation, and severe fatigue. She also has had a 4.5-kg (10-lb) weight gain during this period. Her current medication is daily levothyroxine. She also started taking calcium carbonate supplements 2 months ago for osteopenia of the lumbar spine. At that time, serum concentrations of thyroid-stimulating hormone (TSH) and free thyroxine (FT<sub>4</sub>) were within the reference ranges. Today, physical examination shows coarse, dry skin. Serum studies show a TSH concentration of 16.6  $\mu$ U/mL and FT<sub>4</sub> concentration of 0.3 ng/dL. Which of the following pharmacokinetic changes of levothyroxine is the most likely cause of this patient's current condition?
- (A) Decreased absorption
  - (B) Decreased distribution
  - (C) Decreased elimination
  - (D) Increased distribution
  - (E) Increased elimination
  - (F) Increased metabolism

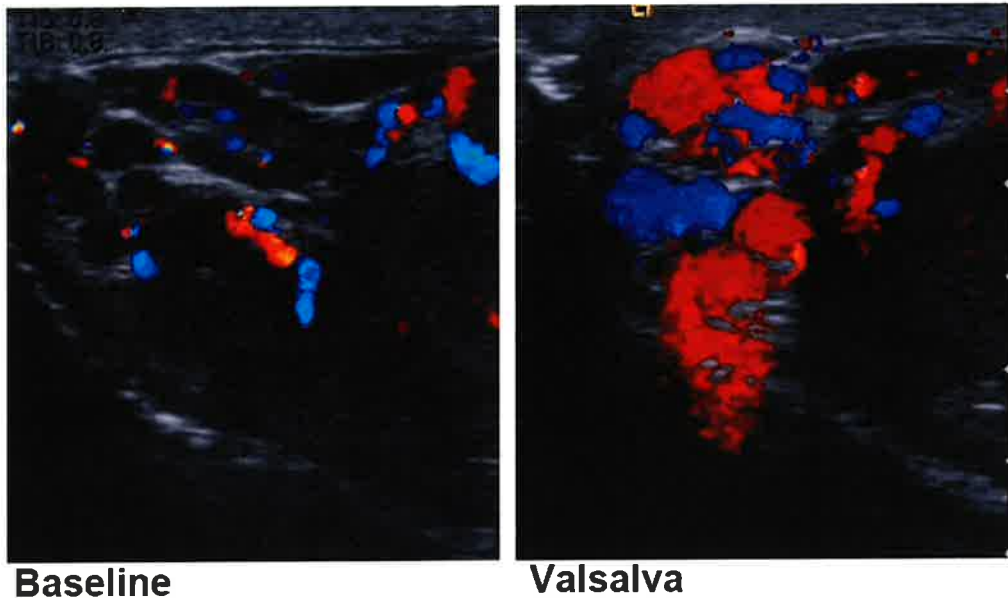


47. A 71-year-old woman comes to the physician because of a 5-day history of a painful rash. The rash began as a burning sensation over the right lower side of her chest. Three days ago, small, flat, painful macules appeared that rapidly progressed to vesicular lesions. During this period, the pain has continually increased in severity. Her temperature is 37.8°C (100°F), pulse is 72/min, respirations are 22/min, and blood pressure is 129/78 mm Hg. Physical examination shows the findings in the photograph. The rash does not cross the midline. The most likely cause of this patient's illness is a deficiency in which of the following components of the immune system?
- (A) Cellular
  - (B) Complement
  - (C) Humoral
  - (D) Phagocytic cell
  - (E) Toll-like receptor
- 

48. A 19-year-old man undergoes splenectomy because of crush injuries sustained in a motor vehicle collision. During the operation, two small accessory spleens are seen adjacent to the ruptured spleen. The most likely origin of this patient's congenital anomaly is thickening of an embryologic layer at which of the following sites?
- (A) Adjacent to the ventral pancreas
  - (B) Along the lesser curvature of the stomach
  - (C) At the origin of the celiac vessels
  - (D) In a portion of the hepatic diverticulum
  - (E) Within the dorsal mesogastrium

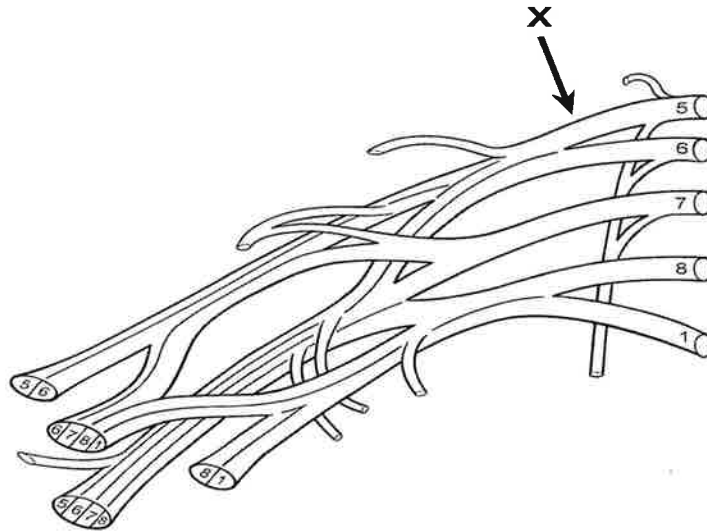
49. A 48-year-old man comes to the physician requesting treatment for alcohol withdrawal. He reports a 30-year history of consuming 6 to 10 beers daily. He has had two citations for driving while intoxicated. He has previously experienced alcohol-associated seizures and withdrawal symptoms. His vital signs are within normal limits. Physical examination shows palmar erythema. The most appropriate pharmacotherapy in this patient most likely has which of the following mechanisms?
- (A) Blockade of dopamine receptors
  - (B) Decreased activity of dopamine transporters
  - (C) Enhancement of the effect of postsynaptic  $\gamma$ -aminobutyric acid (GABA)
  - (D) Increased GABA transaminase activity
  - (E) Inhibition of glutamate release
  - (F) Inhibition of serotonin reuptake
  - (G) Opening of glutamate channels
  - (H) Stimulation of 5-hydroxytryptophan receptors
50. A 48-year-old woman with type 2 diabetes mellitus comes to the physician for a follow-up examination. Current medications are metformin and once-daily insulin. She travels frequently and works long hours. She says that her meals are usually fast food. She leads a sedentary lifestyle. She often forgets to measure her blood glucose concentration. Her last hemoglobin A<sub>1c</sub> was measured as 8.4%. Which of the following is the most appropriate action by the physician to help this patient improve her diabetic control?
- (A) Create an exercise regimen for the patient
  - (B) Explore barriers to diet adherence
  - (C) Increase the patient's insulin dosage
  - (D) Increase the patient's metformin dosage
  - (E) Measure the patient's blood glucose concentration
  - (F) Order measurement of the patient's microalbumin concentration
  - (G) Refer the patient to a nutritionist
51. A 19-year-old man who is a college freshman comes to the office because of a 4-day history of tender, swollen glands. He also has a 6-day history of fever, malaise, and decreased appetite. His temperature is 38.7°C (101.7°F). Physical examination shows swelling of the parotid glands. Which of the following infectious agents is the most likely cause of these findings?
- (A) Epstein-Barr virus
  - (B) Hepatitis B virus
  - (C) Measles virus
  - (D) Mumps virus
  - (E) Rubella virus
52. A 38-year-old woman who is a veteran comes to the emergency department because of a 4-hour history of a sensation of tightness in her throat and swelling of her face, lips, and tongue. She has not had itching. During the past 3 weeks, she has had two similar, milder episodes that resolved without treatment within 24 to 72 hours. Six weeks ago, she began treatment with an ACE inhibitor for hypertension. She has seasonal allergies. Her temperature is 37.1°C (98.8°F), pulse is 80/min, respirations are 20/min, and blood pressure is 138/81 mm Hg. Physical examination shows angioedema of the lips and tongue. There is no evidence of urticaria. Which of the following is the most likely cause of the angioedema in this patient?
- (A) Bradykinin
  - (B) Histamine
  - (C) Leukotriene B<sub>4</sub>
  - (D) Nitric oxide
  - (E) Prostaglandin E<sub>2</sub>





53. A 58-year-old man comes to the physician because of a 6-month history of an enlarging mass in his left scrotum. Physical examination shows a soft, nontender, 2-cm mass in the left scrotum inferior to the inguinal canal; the right testis is normal. Scrotal ultrasonography is done; longitudinal color Doppler images through the mass are shown at rest (Baseline) and during a Valsalva maneuver. Based on the findings shown, there is abnormal dilation of which of the following?
- (A) Cremasteric artery
  - (B) Pampiniform plexus
  - (C) Testicular artery
  - (D) Testicular vein
- 
54. A 48-year-old woman comes to the physician because of a 2-month history of fatigue and poor appetite; she has had a 3-kg (6.6-lb) weight loss during this period. Abdominal examination shows moderate splenomegaly. Laboratory studies show a leukocyte count of  $185,000/\text{mm}^3$  (65% segmented neutrophils with 6% blasts and promyelocytes). Cytogenetic analysis of a bone marrow aspirate shows the presence of the Philadelphia ( $\text{Ph}^1$ ) chromosome in myelocytes. Which of the following mechanisms best accounts for the formation of the Philadelphia ( $\text{Ph}^1$ ) chromosome in this patient?
- (A) Nondisjunction
  - (B) Recombination
  - (C) Sister chromatid exchange
  - (D) Telomere breakage
  - (E) Transposon insertion

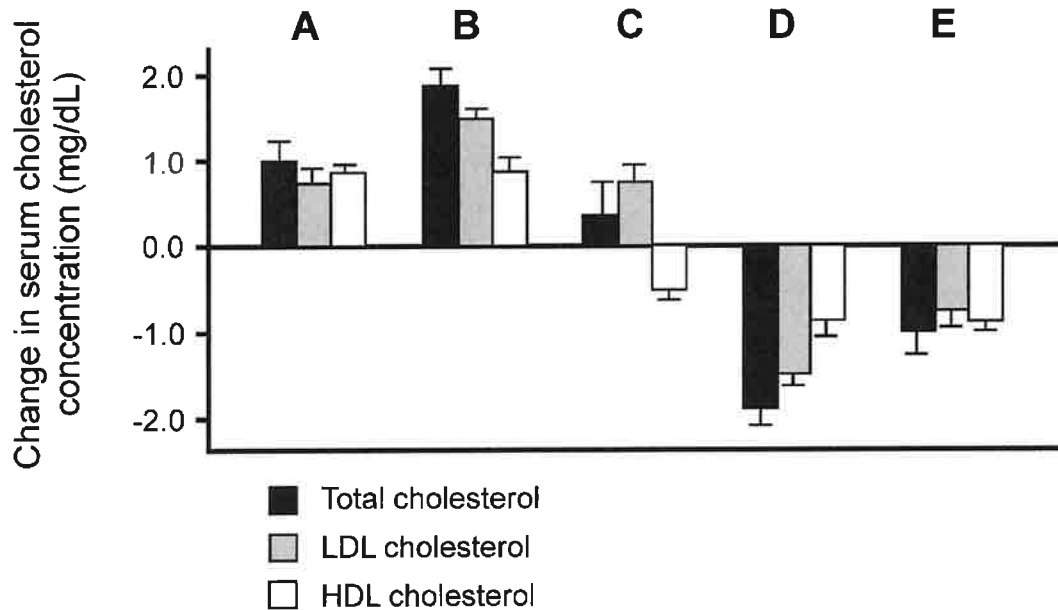
55. A 2-year-old boy is brought to the physician because of failure to thrive. He also has had loose, fatty, foul-smelling stools and a cough during the past 2 weeks. He is at the 30th percentile for height and 10th percentile for weight. Physical examination shows no other abnormalities. Laboratory studies show steatorrhea and a sweat chloride concentration of 80 mmol/L. A chest x-ray shows hyperinflation. Sputum culture grows *Haemophilus influenzae* and *Staphylococcus aureus*. Secretion of which of the following substances is most likely to be decreased in this patient?
- (A) Bicarbonate
  - (B) Gastric acid
  - (C) Glucagon
  - (D) Insulin
  - (E) Intrinsic factor



56. A 19-year-old man is admitted to the hospital 1 hour after he was involved in a motor vehicle collision in which he sustained fractures to the right clavicle, multiple ribs, and the left hip. He was traveling at 40 mph when he was thrown from his motorcycle and struck a tree. He did not lose consciousness. He has no history of serious illness and takes no medications. His temperature is 37.0°C (98.6°F), pulse is 92/min, respirations are 12/min, and blood pressure is 106/72 mm Hg. Examination shows abrasions over the neck, right shoulder, both sides of the rib cage, and left thigh. Cranial nerves are intact. Muscle strength is 5/5 in the left upper and right lower extremities. Muscle strength testing of the left lower extremity is limited by pain. Deep tendon reflexes are 1+ in the right biceps and brachioradialis and 2+ elsewhere. Sensation to cold and pinprick is decreased over the right shoulder. Mental status examination shows no abnormalities. A diagram of the site of the right shoulder injury (arrow) is shown. Further examination is most likely to show weakness of the right upper extremity during which of the following maneuvers?
- (A) Elbow extension
  - (B) Finger abduction
  - (C) Shoulder abduction
  - (D) Thumb flexion
  - (E) Wrist flexion

57. A 10-year-old boy is brought to the physician because of a 3-week history of nosebleeds and easy bruisability. His older brother has had similar episodes. He is at the 30th percentile for height and weight. Physical examination shows nasal and gingival bleeding and several ecchymoses over the trunk and upper and lower extremities in various stages of healing. Laboratory studies show a platelet count of  $300,000/\text{mm}^3$  ( $N=150,000\text{--}400,000$ ). Platelet adhesion testing shows a normal response to ristocetin, but aggregation does not occur in response to thrombin; platelet morphology is normal. Prothrombin time and activated partial thromboplastin time are within the reference ranges. A defect in which of the following is the most likely cause of the findings in this patient?
- (A) Factor VII (proconvertin)
  - (B) Fibrinogen
  - (C) Glycoprotein IIb-IIIa
  - (D) Granule storage pool
  - (E) von Willebrand factor
58. A previously healthy 45-year-old woman who works as a park ranger comes to the physician because of a 1-week history of shortness of breath, even at rest. She has lived in the mountains at 10,000 feet above sea level for 2 years; the physician's office is located at sea level. Her pulse is 85/min, respirations are 18/min, and blood pressure is 125/90 mm Hg. Physical examination while sitting upright shows jugular venous distention and 2+ pedal edema. During the past 2 years, which of the following has most likely decreased in this patient?
- (A) Height of P waves in lead I of the patient's ECG
  - (B) Height of R waves in lead  $V_1$  of the patient's ECG
  - (C) Hematocrit
  - (D) Pulmonary vascular resistance
  - (E) Right ventricular diastolic compliance
  - (F) Right ventricular wall thickness
59. A 25-year-old woman comes to the physician because of a 4-month history of cough and unintentional weight loss. Rhonchi are heard posteriorly over the right upper thorax. A chest x-ray shows an 8-cm cavity in the right upper lobe and hilar lymphadenopathy. Ziehl-Neelsen staining of an induced sputum specimen shows acid-fast bacilli. The patient begins treatment with four antimycobacterial drugs, including rifampin. Synthesis of which of the following components of the suspected pathogen is most likely directly inhibited by the rifampin in this patient's medication regimen?
- (A) ATP
  - (B) Folic acid
  - (C) Peptidoglycan
  - (D) Protein
  - (E) RNA
60. A 34-year-old man is brought to the emergency department 30 minutes after being hit by a motor vehicle while walking. His temperature is  $36^\circ\text{C}$  ( $96.8^\circ\text{F}$ ), pulse is 140/min, respirations are 24/min, and blood pressure is 90/60 mm Hg. During an exploratory laparotomy, a large laceration is found that includes the right and left lobes of the liver. Active bleeding is present. Compression of which of the following ligaments is most likely to decrease bleeding from the liver in this patient?
- (A) Coronary
  - (B) Falciform
  - (C) Gastrohepatic
  - (D) Hepatoduodenal
  - (E) Triangular

61. A 1-month-old boy is brought to the emergency department because of a 1-day history of fever and cough. His temperature is 38.2°C (100.8°F), pulse is 140/min, and respirations are 54/min. Physical examination shows intercostal retractions. Wheezes are heard in all lung fields. A blood culture grows coagulase-negative, catalase-positive, gram-positive cocci in clusters. Which of the following best represents the infectious agent in this patient's blood culture?
- (A) *Staphylococcus aureus*, contaminant
  - (B) *Staphylococcus aureus*, pathogen
  - (C) *Staphylococcus epidermidis*, contaminant
  - (D) *Staphylococcus epidermidis*, pathogen
  - (E) *Streptococcus pneumoniae*, contaminant
  - (F) *Streptococcus pneumoniae*, pathogen
  - (G) *Streptococcus sanguis*, contaminant
  - (H) *Streptococcus sanguis*, pathogen
62. A study is conducted to determine the effects on humans of replacing a portion of dietary carbohydrates with various fatty acids. The serum concentrations of total cholesterol, LDL-cholesterol, and HDL-cholesterol are measured. For every 1% energy increase in dietary trans-18:1 fatty acid, which of the following sets of results is most likely?



63. A new drug, Drug X, is being investigated to determine its pharmacokinetic properties in humans. A male participant who weighs 85 kg (187 lb) with 50 L of total body water begins treatment with an intravenous infusion of Drug X at the rate of 100 mg/h. This drug is known to distribute in total body water. The plasma concentrations of the drug are measured. Results show that the steady-state plasma concentration of Drug X is 50 mg/L. Based on this information, which of the following is the clearance rate of this drug in this man?
- (A) 20 mg/h
  - (B) 100 mg/h
  - (C) 0.22 L/h
  - (D) 2 L/h
  - (E) 22 L/h
64. A 78-year-old woman is admitted to the intensive care unit because of diverticulitis complicated by *Escherichia coli* sepsis. Treatment with ciprofloxacin is started. Three days later, her serum creatinine concentration has increased from 0.7 mg/dL on admission to 1.3 mg/dL. Urinalysis shows muddy brown casts. The most likely cause of the findings in this patient is ischemia of which of the following structures?
- (A) Bowman capsule
  - (B) Glomerulus
  - (C) Interstitium
  - (D) Proximal tubule
  - (E) Renal vein
65. A 34-year-old woman with myasthenia gravis comes to the emergency department because of a 2-day history of increasing weakness, shortness of breath, and abdominal cramping. Current medications are prednisone and pyridostigmine. Her temperature is 37°C (98.6°F), pulse is 45/min, and respirations are 25/min and shallow. Her voice is soft and hypernasal, and she coughs weakly when swallowing water. Breath and heart sounds are normal. Pulmonary testing shows inability to generate a normal negative inspiratory force during forced inspiration. The abdomen is soft and nontender, with increased bowel sounds. Muscle strength is 4/5 diffusely, with severe, continuous, and diffuse fasciculations. Deep tendon reflexes are sluggish, but symmetric. Which of the following is the most likely cause of this patient's weakness?
- (A) Aspiration pneumonia
  - (B) Guillain-Barré syndrome
  - (C) Insufficient dose of prednisone
  - (D) Motor neuron disease
  - (E) Pyridostigmine overdose
66. A 35-year-old woman comes to the office because she has had three first-trimester spontaneous abortions during the past 3 years. Physical examination shows no abnormalities. Laboratory studies show no endocrine abnormalities. Chromosomal analysis shows a paracentric inversion of the long arm of chromosome 1. Which of the following best describes this patient's risk for early spontaneous abortions and a liveborn child with aneuploidy?

	Risk for Early Spontaneous Abortions	Risk for Liveborn Child With Aneuploidy
(A)	High	high
(B)	High	low
(C)	Low	high
(D)	Low	low

67. A 12-year-old boy is brought to the office by his parents for genetic counseling because of a family history of genetic disorders. He has no symptoms or history of major medical illness. The patient's maternal grandfather died of Huntington disease at the age of 35 years. Genetic testing of the mother showed 19 triplet repeats on each huntingtin (*HTT*) allele ( $N=10-20$ ). The patient's paternal grandfather had colon cancer at the age of 30 years, and the father had numerous colon polyps at the age of 20 years treated with a colectomy. Genetic testing of the father shows heterozygosity for a frame-shift mutation in the *APC* gene. Physical examination of the patient shows no abnormalities. Based on this patient's risk for genetic disease, it is most appropriate for the physician to order which of the following genetic tests at this time?
- (A) Analysis of triplet repeat sizes of *HTT*
  - (B) Full sequencing and rearrangement analysis of *APC*
  - (C) Full sequencing of *HTT*
  - (D) Specific testing for the *APC* frame-shift mutation
  - (E) It is not recommended to do predictive genetic testing on a minor



68. A 53-year-old woman comes to the office because of a 6-year history of stiffness and pain of her hands. She has difficulty buttoning her clothes because of the symptoms. She takes no medications. Physical examination shows the findings in the photograph. An abnormality of which of the following is most likely to confirm the diagnosis in this patient?
- (A) Anti-citrullinated peptide antibody
  - (B) Antimitochondrial antibody assay
  - (C) Human leukocyte antigen-DQ2 antibody assay
  - (D) Precursor of the erythroid cell line
  - (E) Precursor of the thrombopoietic line
- 
69. A 25-year-old man comes to the office because of a 4-hour history of irritability, restlessness, tremor, and palpitations. He is a known user of amphetamines. His pulse is 120/min, respirations are 25/min, and blood pressure is 150/100 mm Hg. Physical examination shows no abnormalities. The most likely cause of this patient's symptoms is sympathomimetic activity arising from which of the following?
- (A) Decreased intracellular metabolism of biogenic amines
  - (B) Decreased monoamine oxidase activity
  - (C) Decreased presynaptic receptor activation
  - (D) Increased intracellular metabolism of biogenic amines
  - (E) Increased presynaptic receptor activation
  - (F) Increased release of biogenic amines



70. A 5-year-old girl is brought to the office by her mother because of a 6-hour history of bloody diarrhea. She is interactive and in no acute distress. Her blood pressure is 90/55 mm Hg. Abdominal examination shows normoactive bowel sounds. Stool cultures are obtained, and the patient's mother is advised to give the girl plenty of fluids. Five days later, the patient develops decreased urine output and is brought back to the office. Her blood pressure is now 135/88 mm Hg. Physical examination shows pallor. Laboratory studies show:

Hemoglobin	8.5 g/dL (N=11–15)
Hematocrit	26% (N=28%–45%)
Platelet count	45,000/mm <sup>3</sup> (N=150,000–400,000)
Serum creatinine	3.3 mg/dL (N=0.3–0.7)

Which of the following infectious agents is the most likely cause of these findings?

- (A) *Campylobacter jejuni*
  - (B) *Escherichia coli*
  - (C) Rotavirus
  - (D) *Salmonella enterica* serovar *enteritidis*
  - (E) *Yersinia pestis*
- 

71. A 78-year-old woman is admitted to the hospital because of a 1-week history of jaundice. CT scan of the abdomen shows a mass suggestive of pancreatic cancer. Three hours later, the on-call physician enters the patient's room to discuss the prognosis and obtain consent for a biopsy scheduled for the next morning. On entering the room, the physician greets the patient and her husband. The physician then learns that the patient speaks only Mandarin. Her husband is fluent in Mandarin and English. The hospital interpreter is not available until tomorrow morning. The patient's husband appears anxious and insists that the physician speaks to him and allows him to serve as an interpreter for his wife. Which of the following is the most appropriate next step in management?

- (A) Allow the patient's husband to serve as an interpreter
- (B) Consult the hospital ethics committee
- (C) Explain to the husband that information cannot be provided until the hospital interpreter arrives in the morning
- (D) Use a telephone interpreter service

72. A 4-year-old boy develops fever 3 weeks after being admitted to the hospital for induction chemotherapy for treatment of acute lymphoblastic leukemia. Chemotherapy medications are L-asparaginase, dexamethasone, doxorubicin, and vincristine. His temperature is 38.2°C (100.8°F), pulse is 122/min, and respirations are 24/min. Physical examination shows pallor, alopecia, and ulcerations over the gums. A central venous catheter with entry site in the right upper chest is present but has no surrounding erythema. A blood culture grows gram-negative rods after 36 hours. Which of the following underlying mechanisms is the most likely cause of this patient's susceptibility to infection?

- (A) Deficiency of terminal complement
- (B) Hypogammaglobulinemia
- (C) Impaired T-lymphocyte function
- (D) Inhibition of tumor necrosis factor  $\alpha$  function
- (E) Neutropenia

73. A 65-year-old woman comes to the office for a follow-up examination 1 year after she underwent operative resection of the right colon and chemotherapy for stage III colon cancer. She reports fatigue. Physical examination shows no abnormalities. A staging CT scan of the chest and abdomen shows five new 2- to 3-cm masses in the liver and both lungs. This patient's cancer most likely spread to the lungs via which of the following structures?
- (A) Inferior mesenteric vein
  - (B) Inferior vena cava
  - (C) Left colic vein
  - (D) Middle colic artery
  - (E) Pulmonary vein
  - (F) Superior mesenteric artery
  - (G) Superior vena cava
74. A 6-year-old boy with acute lymphoblastic leukemia is brought to the office for a follow-up examination. He is receiving high-dose methotrexate therapy. A drug is added to the patient's medication regimen to decrease the toxicity of this therapy to normal cells. The beneficial effect of this new drug on normal cells is most likely achieved by bypassing the cellular requirement for which of the following enzymes?
- (A) Dihydrofolate reductase
  - (B) Methionine synthase
  - (C) Pyruvate decarboxylase
  - (D) Thiamine pyrophosphate
  - (E) Thymidylate synthase
75. A 4082-g (9-lb) male newborn is delivered in the hospital at 40 weeks' gestation to a 28-year-old primigravid woman. Pregnancy and delivery were uncomplicated. Apgar scores were 8 and 9 at 1 and 5 minutes, respectively. Examination of the newborn's tongue shows a small blind pit in the midline located near the intersection of the anterior two-thirds and the posterior one-third. Ultrasonography of the neck shows a mass attached to the hyoid bone. Cells in the mass produce a hormone that binds to which of the following?
- (A) G protein-linked receptors
  - (B) Ligand-gated ion channels
  - (C) Nuclear receptors
  - (D) Receptor tyrosine kinases
  - (E)  $\sigma$  Receptors
76. An investigator is studying how mice respond to filarial parasitic infections. Mice deficient in a specific protein found in eosinophils (Group X) are compared with wild-type mice (Group Y). Biopsies of lymph nodes from Group X mice show more adult worms than lymph nodes from Group Y mice. Group X mice most likely lack which of the following?
- (A) Cathelicidin-related antimicrobial peptide
  - (B) Lysozyme
  - (C) Major basic protein
  - (D) Myeloperoxidase
  - (E)  $\alpha$ -Defensin



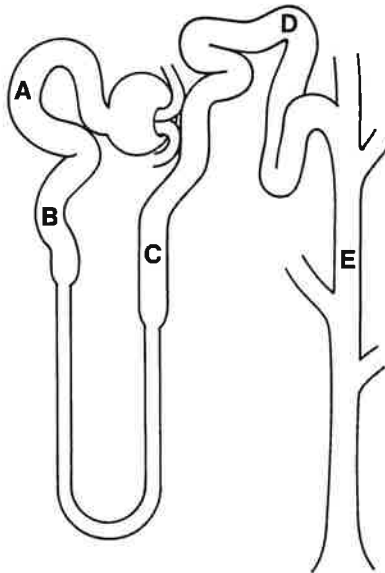


77. A 14-year-old girl is brought to the office by her mother because of a 3-month history of red bumps on her skin. The patient says the bumps are not itchy or painful but that she finds them embarrassing. She has no history of major medical illness and takes no medications. Her vital signs are within normal limits. Physical examination shows the findings in the photograph. Which of the following is the most likely diagnosis?
- (A) Eczema
  - (B) Folliculitis
  - (C) Hidradenitis
  - (D) Keratosis pilaris
  - (E) Urticaria
- 
78. A 50-year-old man comes to the office because of a 2-month history of increasing daytime somnolence. He has obstructive sleep apnea for which he has only intermittently used a continuous positive airway pressure device. He is 170 cm (5 ft 7 in) tall and weighs 181 kg (400 lb); BMI is 63 kg/m<sup>2</sup>. His temperature is 37°C (98.6°F), pulse is 100/min, respirations are 12/min, and blood pressure is 135/80 mm Hg. Physical examination shows a gray-blue tinge to the lips, earlobes, and nail beds. Cardiac examination shows no other abnormalities. Arterial blood gas analysis on room air shows a pH of 7.31, PCO<sub>2</sub> of 70 mm Hg, and PO<sub>2</sub> of 50 mm Hg. Which of the following additional findings would be most likely in this patient?
- (A) Decreased serum bicarbonate concentration
  - (B) Increased hemoglobin concentration
  - (C) Increased total lung capacity
  - (D) Left ventricular hypertrophy

79. An obese 35-year-old man comes to the office for a follow-up examination. He has chronic kidney disease and was told to keep a record of his meals until this follow-up visit. His daily diet consists of chocolate milk and a peanut butter sandwich for breakfast; pizza and cola for lunch; a chocolate bar as a snack; and a foot-long deli meat sandwich for dinner. He is 165 cm (5 ft 5 in) tall and weighs 113 kg (250 lb); BMI is 42 kg/m<sup>2</sup>. His pulse is 100/min, respirations are 23/min, and blood pressure is 155/100 mm Hg. Physical examination shows diaphoresis. Serum studies show a creatinine concentration of 4.1 mg/dL and phosphorus concentration of 6 mg/dL. Which of the following patterns is most likely in this patient?

	Parathyroid Hormone Synthesis	Serum Calcium	Serum 1,25- Dihydroxycholecalciferol
(A)	Downregulated	increased	increased
(B)	Downregulated	increased	decreased
(C)	Downregulated	decreased	decreased
(D)	Upregulated	increased	increased
(E)	Upregulated	increased	decreased
(F)	Upregulated	decreased	decreased

80. A 65-year-old woman has congestive heart failure for which she is treated with an appropriate drug regimen including an ACE inhibitor. Because of insufficient improvement in her symptoms of dyspnea on exertion and edema, the physician prescribes a second agent that results in hyperkalemia. This adverse effect most likely resulted from a drug that targets which of the following labeled locations in the diagram of a nephron?

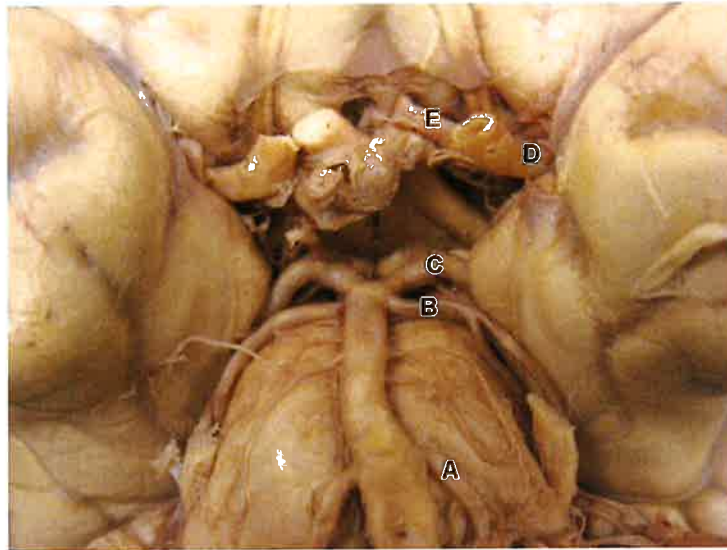


USMLE STEP 1 SAMPLE TEST QUESTIONS

BLOCK 3, ITEMS 81-119

81. A 60-year-old woman is nearing the completion of a half marathon. Because she experiences esophageal regurgitation, she does not drink any liquid during the race. This woman's physical state at the end of the race will most likely activate which of the following renal segments at this time?
- (A) Arginine vasoreceptor 2 in the proximal tubular cells
  - (B)  $K^+-H^+$  exchange in the distal tubule
  - (C) Proximal tubule carbonic anhydrase
  - (D) Urea reabsorption in the medullary collecting ducts
  - (E) Water reabsorption in the ascending loop of Henle
82. An investigator is studying heart development in an experimental animal model. The animal model is genetically modified so that no cardiac neural crest cells develop. This animal model is most likely to have which of the following cardiac abnormalities?
- (A) Atrial septal defect
  - (B) Coarctation of the aorta
  - (C) Mitral stenosis
  - (D) Persistent truncus arteriosus
  - (E) Transposition of the great arteries
83. A 78-year-old woman undergoes an outpatient laparoscopic cholecystectomy. During the procedure, ligation of the cystic artery is planned. It is most appropriate to ligate this artery at its junction with which of the following arteries?
- (A) Gastroduodenal
  - (B) Left gastric
  - (C) Left hepatic
  - (D) Right gastric
  - (E) Right hepatic
84. A 32-year-old man comes to the office because of a 2-week history of fever and throat pain. He is 173 cm (5 ft 8 in) tall and weighs 63 kg (140 lb); BMI is 21 kg/m<sup>2</sup>. His pulse is 110/min, respirations are 16/min, and blood pressure is 98/68 mm Hg. Physical examination shows scattered 2- to 4-cm lymph nodes in the neck, axillae, and inguinal regions. There is a bilateral tonsillar exudate but no ulcerations. Results of laboratory studies are shown:
- |                 |                        |
|-----------------|------------------------|
| Hemoglobin      | 9.6 g/dL               |
| Hematocrit      | 29%                    |
| Leukocyte count | 1500/mm <sup>3</sup>   |
| Platelet count  | 60,000/mm <sup>3</sup> |
- A heterophile antibody test result is negative. Which of the following is the most likely diagnosis?
- (A) Epstein-Barr virus infection
  - (B) Gonococcal pharyngitis
  - (C) HIV infection
  - (D) Lymphogranuloma venereum infection
  - (E) Streptococcal pharyngitis

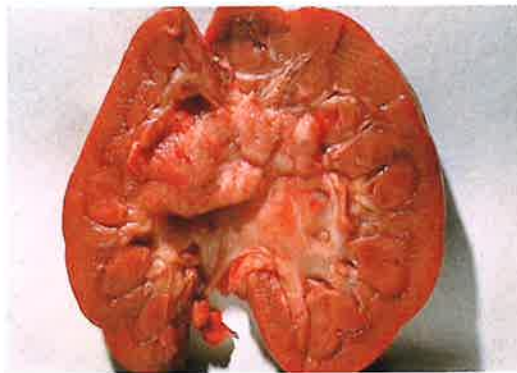
85. A 65-year-old woman with a history of rheumatic mitral valve disease is brought to the emergency department 30 minutes after the sudden onset of right-sided weakness and inability to speak. Neurologic examination shows weakness of the right lower side of the face and difficulty swallowing. Muscle strength is 3/5 on the right side. She can understand what is said to her, but she cannot repeat words or answer questions. An ECG shows atrial fibrillation. The most likely cause of the neurologic findings in this patient is occlusion of which of the following labeled arteries in the photograph of a normal brain?



86. A 51-year-old man with a 10-year history of gastroesophageal reflux and suspected Barrett esophagus comes to the office because his omeprazole dose "doesn't work around the Christmas holidays." He states that he prides himself on having a large appetite and "holding his liquor" during the holidays. He currently takes the maximum dose of omeprazole. Which of the following is the most appropriate initial action by the physician?
- (A) Ask the patient how much he is eating and drinking during the holidays
  - (B) Explain the hazards of untreated reflux in the presence of Barrett esophagus
  - (C) Order an upper endoscopy
  - (D) Refer the patient to a gastroenterologist
  - (E) Switch the omeprazole to pantoprazole
87. A 60-year-old man comes to the office because of weakness, tingling of his hands and feet, irritability, and forgetfulness for 4 months. Physical examination shows pallor, weakness, and spasticity. Deep tendon reflexes are increased. Sensation to vibration is absent in the lower extremities. Laboratory studies show megaloblastic anemia, serum antiparietal cell antibodies, and increased serum concentrations of methylmalonic acid and total homocyst(e)ine. The synthesis of which of the following amino acids is most likely impaired in this patient?
- (A) Cysteine
  - (B) Glutamine
  - (C) Methionine
  - (D) Phenylalanine
  - (E) Tyrosine



88. A 1928-g (4-lb 4-oz) female newborn is delivered in the hospital at 35 weeks' gestation to a 24-year-old primigravid woman. The pregnancy was complicated by a lack of prenatal care. Apgar scores are 3 and 5 at 1 and 5 minutes, respectively. Examination of the newborn shows cyanosis, grunting, and chest retractions. An x-ray of the chest and abdomen is shown; the arrow indicates abnormally placed bowel loops. Based on these findings, which of the following most likely failed to develop normally in this newborn?
- (A) Aortic hiatus
  - (B) Central tendon of the diaphragm
  - (C) Fibrous pericardium
  - (D) Pleuroperitoneal fold
- 



89. A 68-year-old man with alcohol use disorder comes to the office because of a 3-month history of intermittent blood in his urine; he has had no pain. He is a retired laboratory technician from a company that produces naphthylamine. He has smoked 1½ packs of cigarettes daily for 45 years. A CT scan of the abdomen shows a mass in the pelvis of the left kidney. A photograph of the surgically resected kidney is shown. The neoplastic process in this kidney is most likely to be which of the following?
- (A) Angiomyolipoma
  - (B) Metastatic melanoma
  - (C) Nephroblastoma
  - (D) Oncocytoma
  - (E) Urothelial carcinoma
-

90. A 12-year-old girl is brought to the office because of a 2-day history of chest pain. She also had a 3-day history of fever that has since resolved. When she lies down, the pain worsens and she has shortness of breath. Her temperature is 37°C (98.6°F). A friction rub is heard. Which of the following is the most likely causal infectious agent?

(A) Coxsackievirus  
(B) Mumps virus  
(C) *Staphylococcus aureus*  
(D) *Staphylococcus epidermidis*  
(E) Viridans streptococcus

91. A 32-year-old man comes to the office because of a 1-day history of cough productive of small amounts of blood and a 2-day history of shortness of breath and swelling of his ankles. He also has a 2-week history of progressive fatigue and episodes of dark urine. He has no history of major medical illness and takes no medications. His temperature is 37°C (98.6°F), pulse is 90/min, respirations are 18/min, and blood pressure is 175/110 mm Hg. Pulse oximetry on room air shows an oxygen saturation of 91%. Diffuse inspiratory crackles are heard over all lung bases. There is 2+ pitting edema of both ankles. Results of laboratory studies are shown:

Hemoglobin	8.9 g/dL
Hematocrit	27%
Serum	
Urea nitrogen	55 mg/dL
Creatinine	2.9 mg/dL
Urine RBC	20–40/hpf

Urinalysis also shows some dysmorphic RBCs and rare RBC casts. Examination of a kidney biopsy specimen shows crescentic glomerulonephritis and linear deposition of IgG along the glomerular capillaries. This patient most likely has antibodies directed against which of the following antigens?

(A) Collagen  
(B) Double-stranded DNA  
(C) Nucleolar protein  
(D) Phospholipid  
(E) Proteins in neutrophil cytoplasm

- 
92. A 58-year-old man with chronic obstructive pulmonary disease comes to the clinic with his wife for a follow-up examination. He has smoked one pack of cigarettes daily for 35 years. He has tried to quit smoking twice but was unsuccessful both times. At today's visit, when the physician asks the patient about smoking cessation, he says he is not ready to do so. The patient's wife states her husband's smoking makes her cough and gives her chest tightness. Which of the following is the most appropriate physician statement?

(A) "Are there any reasons why you might want to quit smoking?"  
(B) "Are you aware that your lung condition is chronic at this point?"  
(C) "I'm sure you don't want your wife to suffer as a result of your smoking."  
(D) "The majority of your health issues would improve if you quit smoking."  
(E) "Why haven't you been able to stay off cigarettes?"



93. A 26-year-old man comes to the office because of a 1-week history of increased urinary frequency accompanied by excessive thirst. He says he has been urinating hourly. Physical examination shows no abnormalities. Serum chemistry studies are within the reference ranges. Urine osmolality is 50 mOsm/kg H<sub>2</sub>O. After administration of ADH (vasopressin), his urine osmolality is within the reference range. The most likely cause of this patient's symptoms is dysfunction of which of the following structures?

(A) Anterior pituitary gland  
 (B) Bowman capsule  
 (C) Glomerulus  
 (D) Hypophyseal portal system  
 (E) Loop of Henle  
 (F) Supraoptic nucleus

94. A 19-year-old man who is in the US Army is brought to the emergency department 45 minutes after he sustained a knife wound to the right side of his chest during an altercation. He has no history of major medical illness and takes no medications. His temperature is 36.9°C (98.4°F), pulse is 110/min, respirations are 24/min, and blood pressure is 114/76 mm Hg. Pulse oximetry on room air shows an oxygen saturation of 94%. On physical examination, the trachea appears to be shifted to the left. Pulmonary examination of the right chest is most likely to show which of the following findings?

	<b>Fremitus</b>	<b>Percussion</b>	<b>Breath Sounds</b>
(A)	Decreased	dull	decreased
(B)	Decreased	hyperresonant	decreased
(C)	Decreased	hyperresonant	dull
(D)	Increased	dull	bronchial
(E)	Increased	dull	decreased

95. A 45-year-old man comes to the office for a follow-up examination 1 month after routine urinalysis showed an increased protein concentration. He has a 15-year history of type 2 diabetes mellitus and a 10-year history of hypertension. Current medications include hydrochlorothiazide, insulin, and metformin. His blood pressure is 150/80 mm Hg. Physical examination shows no other abnormalities. Daily lisinopril therapy is started. Which of the following sets of changes in glomerular hemodynamics is most likely to occur in this patient as a result of this pharmacotherapy?

	<b>Renal Blood Flow</b>	<b>Ultrafiltration Pressure</b>	<b>Glomerular Filtration Rate</b>
(A)	↑	↑	↓
(B)	↑	↓	↑
(C)	↑	↓	↓
(D)	↓	↑	↓
(E)	↓	↓	↑
(F)	↓	↓	↓

96. A 3438-g (7-lb 9-oz) female newborn is delivered in the hospital at term to a 24-year-old primigravid woman after an uncomplicated pregnancy. Apgar scores are 8 and 9 at 1 and 5 minutes, respectively. Examination of the newborn shows ambiguous genitalia. Results of a blood analysis show markedly increased serum concentrations of 17-hydroxyprogesterone. Genetic analysis shows a karyotype of 46,XX. Further testing of this newborn is most likely to show a deficiency of which of the following enzymes?
- (A) 11 $\beta$ -Hydroxylase
  - (B) 21 $\alpha$ -Hydroxylase
  - (C) 3 $\alpha$ -Hydroxysteroid dehydrogenase
  - (D) 3 $\beta$ -Hydroxysteroid dehydrogenase
  - (E) 5 $\alpha$ -Reductase
  - (F) 17 $\alpha$ -Reductase
97. A 27-year-old woman comes to the emergency department because of a 1-hour history of severe shortness of breath. She has just returned from a cross-country flight. She has a history of borderline hypertension. Her temperature is 36.9°C (98.5°F), pulse is 113/min, respirations are 28/min, and blood pressure is 138/85 mm Hg. Physical examination shows that the right calf has an increased circumference compared with the left calf, and there is tenderness behind the right knee. Which of the following is the most likely underlying cause of this patient's condition?
- (A) Antithrombin III deficiency
  - (B) Factor V Leiden mutation
  - (C) Glanzmann thrombasthenia
  - (D) Protein C deficiency
  - (E) von Willebrand disease
98. A 17-year-old boy is brought to the clinic for a follow-up examination. He has been evaluated for three episodes of full-body weakness at the ages of 13, 16, and 17 years. Each episode occurred when he lay down after playing in a football scrimmage. The weakness improved spontaneously during the next 6 hours; he was asymptomatic by the time he was evaluated by medical personnel. The patient attributes the episodes to eating "a lot of pasta and salty foods" prior to playing football. Results of a complete blood count and comprehensive metabolic profile following each episode have been within the reference ranges. He has no history of serious illness and takes no medications. Vital signs are within normal limits. Physical and neurologic examinations disclose no abnormalities. Which of the following serum concentrations is most likely to be abnormal if measured during one of this patient's episodes?
- (A) Calcium
  - (B) Chloride
  - (C) Magnesium
  - (D) Potassium
  - (E) Sodium
99. A 20-year-old woman is brought to the urgent care center because of a 2-month history of progressive weakness of her arms. She also has a 1-week history of moderate back pain and headache. Her only medication is ibuprofen as needed for pain. Muscle strength is 3/5 in the upper extremities. Sensation to pinprick is decreased over the upper extremities. MRI of the spine shows a central syrinx in the cervical spinal cord. It is most appropriate to obtain specific additional history regarding which of the following in this patient?
- (A) Diet
  - (B) Family illness
  - (C) Recent travel
  - (D) Trauma
  - (E) Unintended weight loss





100. A 24-year-old man comes to the office because of a 3-day history of blisters on the right side of his mouth accompanied by burning pain and a tingling sensation. He underwent a liver transplant 8 years ago for hepatolenticular degeneration (Wilson disease). Current medications are prednisone and tacrolimus. His temperature is 38.0°C (100.4°F), pulse is 78/min, respirations are 14/min, and blood pressure is 120/80 mm Hg. Physical examination shows the findings in the photograph. Well-healed surgical scars are noted on the abdomen. A drug that inhibits which of the following processes is most appropriate for this patient?

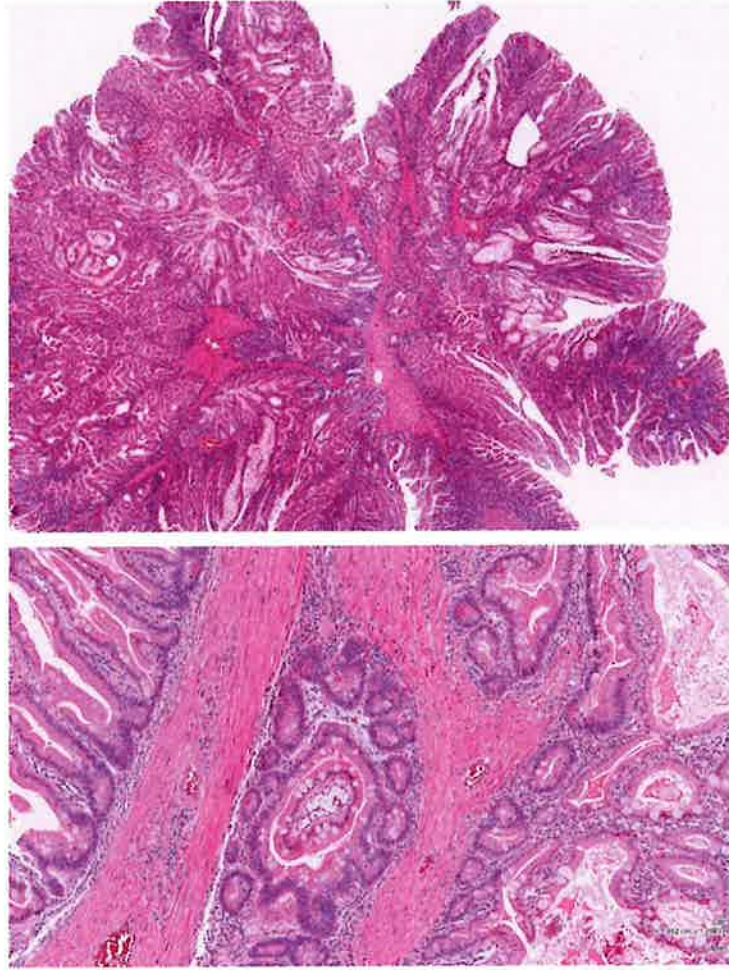
- (A) DNA replication
- (B) Nucleotide phosphorylation
- (C) Protein synthesis
- (D) Viral budding
- (E) Viral uncoating

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101. A 15-year-old girl is brought to the rehabilitation facility for physical therapy. Two months ago, she was involved in a motor vehicle collision in which she sustained a crush injury to the ulnar nerve at the right elbow. Neurologic examination shows severe weakness and atrophy of the intrinsic muscles of the right hand. When the patient is asked to grasp the therapist's fingers, right handgrip is noticeably weaker than left handgrip. Sensation to pinprick and fine touch is decreased at the palmar aspect of the ring and small fingers of the right hand. No other deficits are noted. Which of the following cell types is critical for recovery of neurologic function in this patient?

- (A) Astrocytes
- (B) Oligodendrocytes
- (C) Satellite cells
- (D) Schwann cells
- (E) Tanycytes

102. A 3-year-old boy is brought to the office because of a 2-day history of bulging of his left eye. He says his eye hurts. He has no history of major medical illness or recent trauma to the area, and he receives no medications. Vital signs are within normal limits. Physical examination shows exophthalmos of the left eye. MRI of the brain shows a 2-cm mass involving the ocular muscles of the left eye. A biopsy specimen of the mass shows malignant cells, some of which have striations. Which of the following is the most likely diagnosis?
- (A) Neuroblastoma
  - (B) Pheochromocytoma
  - (C) Retinoblastoma
  - (D) Rhabdomyosarcoma
  - (E) Thyroid cancer
103. An 11-year-old girl is brought to the emergency department by her parents because of a 1-week history of breast enlargement. She has not had pain or nipple discharge. She has asthma treated with inhaled albuterol as needed. She does not smoke cigarettes, drink alcoholic beverages, or use illicit drugs. She is at the 50th percentile for height and weight. Vital signs are within normal limits. Examination of the breasts shows minimal enlargement under the areolae and mild enlargement of the diameter of the areolae without nipple discharge; no masses are palpated. There is scant pubic hair. Which of the following best describes the sexual maturity rating for this patient?
- (A) 1
  - (B) 2
  - (C) 3
  - (D) 4
  - (E) 5
104. A 5-year-old boy is brought to the emergency department by his mother because of an episode of bloody stool 3 hours ago. The mother says the stool was hard "like pebbles" and she noted bright red blood on the tissue when the patient cleaned himself. His previous bowel movement was 5 days ago. The patient has no abdominal or rectal pain now, but he did have abdominal pain during his bowel movement 5 days ago. He has no history of major medical illness and receives no medications. Vaccinations are up-to-date. The patient has no recent history of travel. He is at the 5th percentile for height and the 10th percentile for weight; BMI is at the 50th percentile. Vital signs are within normal limits. Abdominal examination shows hypoactive bowel sounds and a soft, slightly distended abdomen that is not tender to palpation. Rectal examination shows 1 cm of bright red rectal mucosa protruding from the right side of the anus; there is no rectal bleeding. The remainder of the examination shows no abnormalities. Which of the following is the most likely cause of this patient's physical findings?
- (A) Constipation
  - (B) Cystic fibrosis
  - (C) Hirschsprung disease
  - (D) Hookworm infestation
  - (E) Intussusception



105. A 5-year-old boy is brought to the office by his mother because of a 2-week history of intermittent bloody stools. He is otherwise asymptomatic. He has no history of major medical illness and receives no medications. He does not appear to be in distress. Vital signs are within normal limits. Physical examination shows no abnormalities. Laboratory studies show mild, normocytic anemia; other results are within the reference ranges. Test of the stool for occult blood is positive. Photomicrographs of biopsy specimens obtained on colonoscopy are shown. Which of the following is the most likely diagnosis?
- (A) Adenocarcinoma
  - (B) Carcinoid tumor
  - (C) Hamartomatous polyp
  - (D) Hyperplastic polyp
  - (E) Inflammatory polyp
  - (F) Tubular adenoma
-

106. An 80-year-old woman is brought to the emergency department (ED) 30 minutes after she fell out of her wheelchair at home. This is the second visit to the ED for a fall during the past 3 months. She lives with her daughter and son-in-law, who say they “do the best we can.” The patient has dementia, Alzheimer type, coronary artery disease, type 2 diabetes mellitus, and hypertension. Current medications are amlodipine, aspirin, atorvastatin, donepezil, long-acting insulin, and lisinopril. Five years ago, she underwent bilateral below-the-knee amputations because of infected ulcers of the feet. She uses a wheelchair for ambulation. Ten years ago, she underwent three-vessel coronary artery bypass grafting. She has smoked one-half pack of cigarettes daily for 60 years. She drinks one shot of whiskey nightly. She is thin and appears ill and disheveled. Her temperature is 37.2°C (99.0°F), pulse is 80/min, respirations are 20/min, and blood pressure is 120/80 mm Hg. Pulse oximetry on 2 L/min of oxygen by nasal cannula shows an oxygen saturation of 95%. Physical examination shows temporal wasting. There are scattered ecchymoses over the abdomen and all extremities. No other abnormalities are noted. Which of the following is the most appropriate initial history to obtain from this patient?
- (A) Abnormal bleeding
  - (B) Diet
  - (C) Relationship with her family
  - (D) Respiratory symptoms
  - (E) Urinary symptoms
107. An investigator is studying the impact of glucocorticoids on leukocyte dynamics in an experimental animal model. After dexamethasone administration, the total number of circulating neutrophils increases. Most of the additional neutrophils in circulation are detached; these neutrophils were previously loosely adherent and rolling along the endothelium. The expression of which of the following cell adhesion molecules is most likely decreased in this animal model after dexamethasone administration?
- (A) Cadherin
  - (B) Intercellular adhesion molecule-1
  - (C) L-selectin
  - (D) MAC-1
  - (E) Very late antigen-4
108. A 67-year-old man comes to the office because he is concerned about memory loss. He says he sometimes forgets the names of acquaintances he sees while he is out shopping. He also has occasional word-finding difficulty and forgets to buy some items when he goes shopping unless he makes a list. He lives alone and is able to manage his finances, cook, and shop without help. He works part-time as an accountant. He has gastroesophageal reflux disease and hypertension. Current medications are hydrochlorothiazide and omeprazole. Vital signs are within normal limits. Physical and neurologic examinations show no abnormalities. On mental status examination, he is fully oriented. His speech is normal, and thoughts are organized. His mood is euthymic, and he has a full range of affect. His concentration is intact, and he is able to perform calculations quickly and accurately. He can name objects accurately and follow written and verbal commands. He recalls three of four objects after 5 minutes. Which of the following is the most appropriate physician response to this patient’s concern?
- (A) “I am concerned about your memory loss. Let’s discuss how to further evaluate your memory.”
  - (B) “There’s no need to worry right now, but let’s meet again in 6 months.”
  - (C) “Unfortunately, your memory loss will likely increase significantly during the next 5 years; let’s discuss some ways to plan for the future.”
  - (D) “Your episodes of forgetfulness are likely just ‘Senior Moments,’ but we should obtain in-depth laboratory test results and an MRI to be certain.”
  - (E) “Your examination findings indicate that your memory loss is likely consistent with the normal aging process.”

109. A 30-year-old woman comes to the office because of a 4-day history of an increasingly severe, painful rash over her body and in her mouth. The rash began over her trunk area but spread within a day to her face and extremities. Two days before development of the rash, she had flu-like symptoms with muscle aches and fatigue as well as a nonproductive cough, sore throat, and runny nose. Ten days ago, she began treatment with trimethoprim-sulfamethoxazole for a urinary tract infection; she takes no other medications. Temperature is 39.0°C (102.2°F), pulse is 120/min, respirations are 25/min, and blood pressure is 165/105 mm Hg. Physical examination shows diffuse brownish red macular exanthema with bullous lesions. Epidermis at an uninvolved site can be removed with mild tangential pressure. Examination of a biopsy specimen of one of the lesions shows necrosis of keratinocytes throughout the epidermis. There is minimal lymphocytic infiltration within the superficial dermis. Which of the following is the most likely diagnosis?

- (A) Erythema multiforme
- (B) Linear IgA bullous dermatosis
- (C) Pemphigus vulgaris
- (D) Staphylococcal scalded skin syndrome
- (E) Toxic epidermal necrolysis

110. A 45-year-old woman comes to the office for a follow-up examination 2 weeks after she sustained a vertebral fracture at L1. The fracture occurred spontaneously and there is no history of trauma to the area or other fractures. She gained 27 kg (60 lb) during the 6 months before the fracture occurred. Her only medication is hydromorphone as needed for pain. She is 163 cm (5 ft 4 in) tall and now weighs 100 kg (220 lb); BMI is 38 kg/m<sup>2</sup>. Temperature is 37.0°C (98.6°F), pulse is 86/min, respirations are 12/min, and blood pressure is 145/98 mm Hg. Physical examination shows central obesity and purple striae over the abdomen bilaterally. The lower extremities appear thin. Results of laboratory studies are shown:

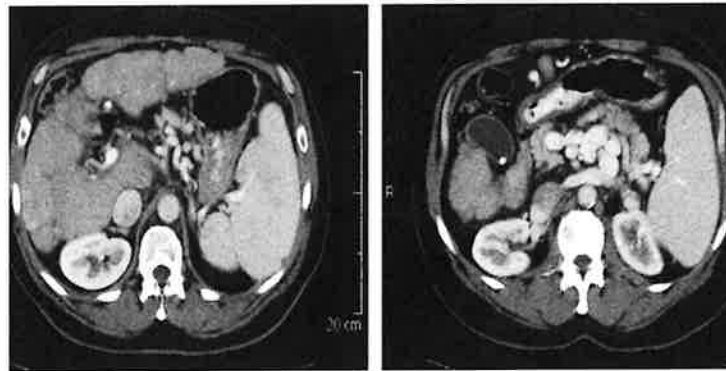
Plasma	
Renin activity	5.0 ng/mL/hr (N=0.6–4.0)
Metanephrine	0.3 nmol/L (N<0.4)
Serum	
Cortisol, random	43 µg/dL
Adrenocorticotrophic hormone	120 pg/mL (N<120)
Aldosterone	8 ng/dL (N=2–9)
Urine 24-hour free cortisol excretion	340 µg/24 h (N=3.5–45)

The most likely cause of the fracture in this patient is an increase in which of the following processes?

- (A) Calcium absorption
- (B) Calcium excretion
- (C) Osteoblast proliferation
- (D) Osteoclast proliferation
- (E) Phosphorus absorption
- (F) Phosphorus excretion



111. A 25-year-old woman comes to the emergency department because of a 3-hour history of fever, severe headache, light-headedness, dizziness, shaking chills, and muscle aches. Five hours ago, she was diagnosed with Lyme disease and began doxycycline therapy. She has no other history of serious illness and takes no other medications. Menses occur at regular 28-day intervals. She is currently menstruating and using a tampon. She appears anxious. Temperature is 37.0°C (98.6°F), pulse is 120/min, respirations are 30/min, and blood pressure is 90/60 mm Hg. Pulse oximetry on room air shows an oxygen saturation of 94%. Physical examination shows flushing and diaphoresis. Cardiopulmonary examination shows no other abnormalities. Which of the following is the most likely mechanism of this patient's current condition?
- (A) Exacerbation of infection by *Borrelia burgdorferi*
  - (B) Infection-mediated sepsis
  - (C) IgE-mediated allergic reaction to doxycycline
  - (D) Release of bacterial products producing acute inflammation
  - (E) Secretion of bacterial endotoxins
112. A 2-week-old male newborn is brought to the office for a well-child examination. He was delivered following an uncomplicated, spontaneous vaginal delivery at 41 weeks' gestation. The mother has no history of serious illness and did not receive prenatal care. Her only medication is a prenatal vitamin. She has consumed large amounts of vodka nightly for 10 years. Which of the following examination findings is most likely to be present in this patient?
- (A) Hypospadias
  - (B) Limb hypoplasia
  - (C) Neck webbing
  - (D) Short palpebral fissures
  - (E) Spasticity



113. A 52-year-old man is admitted to the hospital because of a 2-hour history of vomiting bright red blood. His pulse is 125/min, and blood pressure is 90/60 mm Hg. Physical examination shows jaundice and visible blood vessels surrounding the umbilicus. CT scans of the abdomen are shown. To decrease portal venous pressure in this patient, it is most appropriate to place a shunt between the portal vein and which of the following additional vessels?
- (A) Inferior mesenteric vein
  - (B) Inferior vena cava
  - (C) Left gastric vein
  - (D) Splenic vein
  - (E) Superior mesenteric vein



114. A 57-year-old man with chronic low back pain comes to the office for a routine health maintenance examination. The patient's last visit to the office was 2 years ago, and today he says he is "doing about the same," except for an unintentional 10-kg (22-lb) weight gain. He attributes the weight gain to inability to exercise because of his back pain, and he is now considering applying for disability benefits. He was evaluated by a back pain specialist 3 months ago and underwent an MRI of the lumbar spine at that time; however, he says he did not understand the specialist's explanation regarding the MRI results and requests further explanation. Medical history also is remarkable for hyperlipidemia, seasonal allergies, and opioid use disorder; he has not used opioids of any kind since he stopped prescription oxycodone use 5 years ago. Routine medications are atorvastatin, diclofenac, and loratadine. He develops skin flushing when taking niacin, but he has no known drug allergies. He has smoked two packs of cigarettes daily for 25 years. He previously drank two beers daily, but he has not consumed any alcoholic beverages or used any recreational drugs for the past 5 years. He is 178 cm (5 ft 10 in) tall and weighs 104 kg (230 lb); BMI is 33 kg/m<sup>2</sup>. Vital signs are within normal limits; blood pressure is 128/70 mm Hg. While standing, the patient leans forward slightly. Range of motion on lumbar extension and flexion is decreased. The remainder of the examination discloses no abnormalities. Results of fasting serum studies are shown:

Na <sup>+</sup>	140 mEq/L
K <sup>+</sup>	4.7 mEq/L
Cl <sup>-</sup>	100 mEq/L
HCO <sub>3</sub> <sup>-</sup>	24 mEq/L
Urea nitrogen	15 mg/dL
Creatinine	0.7 mg/dL
Cholesterol	
Total	230 mg/dL
HDL	60 mg/dL
LDL	154 mg/dL
Triglycerides	80 mg/dL

MRI of the lumbar spine is shown. Which of the following factors in this patient's history most strongly contributed to the MRI findings?

- (A) Alcohol consumption
- (B) Cigarette smoking

- (C) Diclofenac use
  - (D) Loratadine use
  - (E) Opioid use
- 

115. A 15-year-old boy is brought to the office by his parents to discuss results of a biopsy done 3 days ago for a rapidly enlarging neck mass. He first noted the mass 1 month ago. Two weeks ago, he was evaluated for an episode of prolonged epistaxis and was found to have a right ear effusion, which was treated with amoxicillin-clavulanic acid. He has no other history of serious illness and takes no medications. Height is at the 10th percentile, weight is at the 50th percentile, and BMI is at the 75th percentile. Vital signs are within normal limits. Physical examination shows a right ear effusion and a 4-cm, firm mass in the right posterior triangle of the neck. Results of a biopsy specimen show squamous epithelium with indistinct cell margins, enlarged atypical nuclei, and absent keratin formation. Which of the following infectious agents is the most likely underlying cause of this patient's current condition?
- (A) Cytomegalovirus
  - (B) Epstein-Barr virus
  - (C) HIV
  - (D) Human herpesvirus 8
116. A 14-year-old boy is brought to the emergency department by his parents because of a 1-month history of intermittent right knee pain that has worsened during the past day. He rates his current pain as a 6 on a 10-point scale and says that it worsens when he walks and lessens when he sits. During the past 2 weeks, he has been walking 1 mile daily in preparation for participation in the school marching band. He has not taken any medications for his pain. He sustained a right tibia and fibula fracture at the age of 8 years after a skateboarding accident, which was treated with internal fixation and casting. He has asthma treated with inhaled budesonide daily and inhaled albuterol as needed. His mother has type 2 diabetes mellitus, and his maternal grandmother has osteoporosis. The patient is 170 cm (5 ft 7 in; 77th percentile) tall and weighs 88 kg (195 lb; >95th percentile); BMI is 31 kg/m<sup>2</sup> (98th percentile). Temperature is 37.0°C (98.6°F), pulse is 95/min, and blood pressure is 130/80 mm Hg. Physical examination shows hyperpigmented, thickened skin at the nape of the neck. There is tenderness to palpation of the anterior aspect of the right hip and limited range of motion on abduction, internal rotation, and flexion of the right hip. The left hip and knees are nontender; range of motion is full in all directions. The remainder of the examination discloses no abnormalities. Which of the following factors in this patient's history most increased his risk for developing this condition?
- (A) BMI
  - (B) Family history
  - (C) Medication use
  - (D) Previous fractures
  - (E) Recent physical activity



117. A 38-year-old woman comes to the clinic to discuss results of a biopsy specimen of a mass in the right breast obtained 1 week ago. She has no history of serious illness and takes no medications. Vital signs are within normal limits. Examination of the right breast shows a well-healing biopsy incision. The remainder of the examination discloses no abnormalities. Results of the biopsy specimen disclose ductal carcinoma in situ. The physician informs the patient he has some bad news to share and tells her the diagnosis. He explains her treatment options, including mastectomy, breast-conserving surgery, radiation therapy, chemotherapy, and any combination of these options. The patient appears afraid but listens attentively before responding, "You're the doctor. My children are still little. Tell me what I should do." In addition to expressing empathy, which of the following is the most appropriate physician response?
- (A) "As the patient, you really should make any decision you feel is best for you."
  - (B) "Before I make recommendations, can you tell me what you understand about your options?"
  - (C) "Given the stage of the cancer, I recommend mastectomy."
  - (D) "How important is it to you to keep your breasts?"
  - (E) "Would you like to discuss these options further with your family?"
  - (F) "Would you like to think your options over and schedule another visit to discuss them further?"
  - (G) "You said you have young children. How old are they?"
118. A 36-year-old woman with hypertension comes to the office because she thinks she may be "going through early menopause." She has not had a menstrual period since her most recent office visit 6 months ago. During this time, she also has been "gaining weight around the middle" despite increased exercise; she has had a 6.3-kg (14-lb) weight gain. She has no other history of major medical illness. Her only medication is lisinopril. She does not smoke, drink alcohol, or use illicit drugs. She is 168 cm (5 ft 6 in) tall and weighs 107 kg (236 lb); BMI is 38 kg/m<sup>2</sup>. Vital signs are within normal limits. Examination shows a uterus consistent in size with a 24-week gestation. Pelvic ultrasonography shows oligohydramnios and a fetus with a misshapen cranium, pericardial effusion, small bladder, and echogenic bowel. The most likely cause of the fetal abnormalities in this patient's pregnancy is interference with which of the following?
- (A) Fetal lung/epithelial differentiation
  - (B) Fetal lung/surfactant development
  - (C) Fetal renal hemodynamics
  - (D) Maternal placental perfusion
  - (E) Maternal prostaglandin synthesis
119. A 25-year-old woman, gravida 1, para 1, comes to the office because of a 2-week history of palpitations and heat intolerance. She delivered her child 3 months ago following an uncomplicated pregnancy and delivery. She is breast-feeding. She has no history of serious illness and takes no medications. She is 163 cm (5 ft 4 in) tall and weighs 54 kg (120 lb); BMI is 21 kg/m<sup>2</sup>. Temperature is 37°C (98.6°F), pulse is 106/min, respirations are 20/min, and blood pressure is 124/68 mm Hg. Examination shows moist palms and bilateral lid lag. No exophthalmos is noted. The thyroid gland is enlarged and nontender. No murmurs are heard on cardiac examination. Deep tendon reflexes are 3+. Serum studies show an undetectable TSH concentration, thyroxine (T<sub>4</sub>) concentration of 20 µg/dL, and triiodothyronine (T<sub>3</sub>) concentration of 275 ng/dL. Which of the following is the most likely mechanism of this patient's symptoms?
- (A) Activation of mutations of TSH receptors
  - (B) Increased serum thyroglobulin concentration
  - (C) Ischemic injury to the hypothalamus
  - (D) Lymphocytic infiltration of the thyroid
  - (E) Presence of TSH receptor autoantibodies

ANSWER FORM FOR USMLE STEP 1 SAMPLE TEST QUESTIONS

**Block 1 (Questions 1–40)**

1.	—	11.	—	21.	—	31.	—
2.	—	12.	—	22.	—	32.	—
3.	—	13.	—	23.	—	33.	—
4.	—	14.	—	24.	—	34.	—
5.	—	15.	—	25.	—	35.	—
6.	—	16.	—	26.	—	36.	—
7.	—	17.	—	27.	—	37.	—
8.	—	18.	—	28.	—	38.	—
9.	—	19.	—	29.	—	39.	—
10.	—	20.	—	30.	—	40.	—

**Block 2 (Questions 41–80)**

41.	—	51.	—	61.	—	71.	—
42.	—	52.	—	62.	—	72.	—
43.	—	53.	—	63.	—	73.	—
44.	—	54.	—	64.	—	74.	—
45.	—	55.	—	65.	—	75.	—
46.	—	56.	—	66.	—	76.	—
47.	—	57.	—	67.	—	77.	—
48.	—	58.	—	68.	—	78.	—
49.	—	59.	—	69.	—	79.	—
50.	—	60.	—	70.	—	80.	—

**Block 3 (Questions 81–119)**

81.	—	91.	—	101.	—	111.	—
82.	—	92.	—	102.	—	112.	—
83.	—	93.	—	103.	—	113.	—
84.	—	94.	—	104.	—	114.	—
85.	—	95.	—	105.	—	115.	—
86.	—	96.	—	106.	—	116.	—
87.	—	97.	—	107.	—	117.	—
88.	—	98.	—	108.	—	118.	—
89.	—	99.	—	109.	—	119.	—
90.	—	100.	—	110.	—		

**ANSWER KEY FOR USMLE STEP 1 SAMPLE TEST QUESTIONS**

**Block 1 (Questions 1–40)**

1. B	11. H	21. F	31. B
2. E	12. B	22. D	32. C
3. D	13. E	23. E	33. D
4. A	14. D	24. B	34. D
5. E	15. A	25. A	35. C
6. A	16. D	26. B	36. A
7. B	17. A	27. A	37. C
8. B	18. C	28. A	38. E
9. G	19. A	29. A	39. A
10. D	20. C	30. A	40. B

**Block 2 (Questions 41–80)**

41. D	51. D	61. C	71. D
42. B	52. A	62. C	72. E
43. A	53. B	63. D	73. B
44. B	54. B	64. D	74. A
45. D	55. A	65. E	75. C
46. A	56. C	66. B	76. C
47. A	57. C	67. D	77. D
48. E	58. E	68. A	78. B
49. C	59. E	69. F	79. F
50. B	60. D	70. B	80. E

**Block 3 (Questions 81–119)**

81. D	91. A	101. D	111. D
82. D	92. A	102. D	112. D
83. E	93. F	103. B	113. B
84. C	94. B	104. A	114. B
85. D	95. C	105. C	115. B
86. A	96. B	106. C	116. A
87. C	97. B	107. C	117. B
88. D	98. D	108. E	118. C
89. E	99. D	109. E	119. D
90. A	100. A	110. D	

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## Step 1 Exam Content

### Overview

Step 1 assesses whether you understand and can apply important concepts of the sciences basic to the practice of medicine, with special emphasis on principles and mechanisms underlying health, disease, and modes of therapy. Step 1 ensures mastery of not only the sciences that provide a foundation for the safe and competent practice of medicine in the present, but also the scientific principles required for maintenance of competence through lifelong learning. Step 1 is constructed according to an integrated content outline that organizes basic science material along two dimensions: system and process.

Step 1 is a one-day examination. It is divided into seven 60-minute blocks and administered in one 8-hour testing session. The number of questions per block on a given examination form may vary, but will not exceed 40. The total number of items on the overall examination form will not exceed 280.

The examination also includes a minimum allotment of 45 minutes of break time and a 15-minute optional tutorial. The amount of time available for breaks may be increased by finishing a block of test items or the optional tutorial before the allotted time expires.

Practice materials, which include [an interactive testing experience and tutorial](#), and sample test items in a PDF document, as well as other informational materials, are available. Examinees must also read the [USMLE Bulletin of Information](#).

### Important

- The term *item* is used to describe a test question in any format.
- You **must** run the [Step 1 interactive testing experience](#) to become familiar with the test software **prior to your test date**.
- The tutorial provided at the beginning of the Step 1 examination has fewer screens and less detailed information than the [Step 1 interactive testing experience](#).
- The [Step 1 interactive testing experience](#) includes items with associated audio findings. Become familiar with how these types of test items function before your test date.

Please visit the USMLE website often to view announcements, regarding changes in test delivery software, and to access updated practice materials. You must obtain the most recent information before taking any USMLE.

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